INSTRUMENT READINESS REVIEW

OF

NSLS–II 18-ID FULL FIELD X-RAY IMAGING (FXI) BEAMLINE AND FRONT END

October 25, 2017

NSLSII-18ID-RPT-003

BROOKHAVEN
NATIONAL LABORATORY

An Instrument Readiness Review (IRR) of the NSLS-II 18-ID Full Field X-Ray Imaging (FXI) Beamline and Front End was conducted on October 18th and 25th, 2017 with NSLS II staff. The review team identified no pre-start items for the front end and found two pre-start items for the beamline along with a third pre-start item related to configuration changes of one of the radiation safety components. In addition, the team identified eight post-start items along with a range of observations, recommendations, and five noteworthy practices.

INSTRUMENT READINESS REVIEW

OF

NSLS-II 18-ID FULL FIELD X-RAY IMAGING (FXI) BEAMLINE

AND

FRONT END

TEAM MEMBERS

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TABLE OF CONTENTS

Summary 1

1. Introduction 5

    1.1. Purpose and Scope of Instrument Readiness Review 5

    1.2. Review Process and Method 5

    1.3. Definitions 6

    1.4. Composition of the IRR Team 7

2. Findings/Conclusions 9

    2.1. Pillar I – Documentation 9

    2.2. Pillar II – Hardware and Physical Plant 12

    2.3. Pillar III – Personnel 17

3. Readiness Determination 19

4. Summary of Pre-Start and Post-Start Findings 20

Appendix A – Charge and Review Team 22

Appendix B – Review Agenda 23

Appendix C – Readiness Plan for 18-ID 24

Appendix D – IRR Preliminary Report 31

SUMMARY

This report provides a summary of the Instrument Readiness Review (IRR) completed at the Brookhaven National Laboratory (BNL) National Synchrotron Light Source II (NSLS-II) for the 18-ID Full Field X-ray Imaging (FXI) beamline and front end. The IRR is a structured method for comprehensively verifying that the hardware, procedures, personnel, and processes needed for beamline commissioning are ready to permit these activities to be undertaken in a safe, effective, and environmentally sound manner. A team of BNL Subject Matter Experts was assembled to complete this review. The team members are identified in section 1.4.

The scope of this review was defined in Instrument Readiness Plans (IRP) developed specifically for 18-ID (NSLSII-18ID-PLN-003). This document was developed to assure completion of the documentation, hardware, procedures, and personnel qualification requirements associated with installation and the planned commissioning of this beamline.

The review team first met on 18 October 2017 to receive presentations delivered by NSLS-II staff discussing the scientific and technical features of the beamline and front end as well as their readiness for commissioning. These presentations were followed by a tour of the beamline and front end for visual inspection. The review was completed on a second day, 25 October 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, resolve certain issues and concerns regarding component configuration and readiness raised by the IRR team and complete the mechanical survey report and other documentation requirements. During the period between the first and second day of the review, members of the review team also continued to probe readiness areas and prepare for the final day of the review. The method of the review 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.

It was noted that since the source for 18-ID is a damping wiggler and the wiggler was needed for storage ring operation to preserve beam emittance, the source and a portion of the front end had been installed as part of the original NSLS-II project. The wiggler and the partially completed front end were reviewed in December 2014 as part of a limited-scope readiness review and had since been in use. The installation of the remaining front-end components was completed in August 2017 and included the ratchet wall collimator. The completed front end was subsequently reviewed in a previous IRR conducted on 29 August 2017. The scope of the present review includes the front-end components and configuration not previously reviewed as well as the beamline and end station. Among other items, this included the interface of the photon shutter with the Equipment Protection and Personnel Protection systems.

The team concluded that there were no pre- or post-start findings associated with the front end of 18-ID. After careful review of the beamline components and documentation as well as considerable discussion with NSLS-II staff, the team agreed on three pre-start findings with respect to the beamline. In addition, the team agreed on several post-start findings.

One of the pre-start findings for 18-ID concerns the requirements of the Radiation Safety Component Checklist (NSLSII-R-XFD-CHK-022). The checklist requires that the hard stops for the collimator mirror vertical stages are in place and labeled per a photograph located near the hard stops, but the photograph does not actually show the hard stops. Hence, the configuration cannot be properly verified. In addition, the team also found a variety of other deficiencies with the checklist including missing photos next to components as required by the checklist. These deficiencies were corrected before the review was concluded.

The team also found that the testing report for the Beamline Equipment Protection System (PS-R-XFD-EPS-CHK-001) did not include test results for several insertable flags in the First Optics Enclosure (FOE). The team deemed this a pre-start finding.

Finally, the team's most significant finding was that the present constraints on the motion of the collimator mirror in the FOE were not sufficient for safe operation. The mirror is a radiation safety component, and the team agreed that insufficient analysis had been conducted on the hard stops of the mirror to establish their reliability to constrain the motion of the mirror. Furthermore, the radiation fields generated by potentially missteered beam due to failure of the hard stops to constrain the motion of the mirror had also been insufficiently analyzed.

After discussion of these concerns with members of the NSLS-II staff including the lead beamline scientist, engineering and technical staff as well as NSLS-II management, the Commissioning Plan was modified (NSLSII-18ID-PLN-004, Rev. 2, 24 October 2017) to provide constraints on commissioning activities and the motion of the mirror based on the beam current delivered to the beamline.

The team has no pre-start finding for the proposed mode of operation as outlined in the modified commissioning plan; however, the review team agreed that to operate outside of the constraints in the commissioning plan identified above will require further evaluation by this team.

In addition to the pre-start findings, the team also identified several post-start findings. Among these, the team found that the final report of the Radiation Safety Committee did not clarify an exception made to the ray trace procedure for analyzing the clearance of the synchrotron fan extremal ray due to the motion of the mirror permitted by the hard stops to the pink beam stop.

The team also found that documentation was missing for one traveler, and, in several cases, the required information, including the data and other pertinent data were found to be missing for several travelers. In other cases, the travelers were not properly executed or modified with

some cross-outs not appearing in red or not initialed as required. These errors are also noted as a post-start finding.

The team found instances of inconsistent or incomplete labeling of hardware components. This was identified as a post-start finding.

Furthermore, the team found that the photos being used for configuration and guidance along the beamline did not meet the minimum requirements for operator aids. Moreover, some photos were noted to be missing, as described above with respect to radiation safety components. The team concluded that these deficiencies are a post-start finding.

A temperature controller had failed during the review due to a faulty component. Manual setting of the temperature was possible, and it the NSLS-II staff indicated that a replacement part was on order. This was noted as a post-start finding.

Another post-start finding concerned the mirrors used in the search-and-secure procedure for both hutches for 18-ID. After inspection, the team concluded that the mirrors may require adjustment to ensure that the entire hutch is visible during the search procedure. In addition, several terminal strips were found to be missing covers in hutch A.

Also, the team discovered that flow components were mislabeled during the verification of drawings. In particular, the team found that one of the drawings had omitted the usual tag ID numbers for flow components and that these numbers had been assigned to other components unrelated to the flow instruments. Upon discussion with NSLS-II staff, a scheme for resolving this issue was devised and the problem was resolved.

The team made a wide range of observations including opportunities for improvement that are detailed in the report. Among these are:

- Potential streamlining of commissioning and radiation survey procedures,
- Possible changes to the process for granting authorization to commissioning that separate findings for the front end and the beamline,
- Leak and pressure testing forms for front-end utilities that were not fully completed with important test data,
- Potential streamlining and improvement of leak and pressure test documentation,
- The need to replace missing covers to terminal strips in the 18-ID A hutch,
- Recommendation to add control of slit motion as a criterion for readiness and to refine process for passing control to beamline operators,
- Removal and replacement of temporary/handwritten labels with permanent labelling of utilities.

In addition, there were several noteworthy practices including:

- Excellent documentation of most piping components allowing for simple and rapid verification of design and installation,

- Rapid review of design and vendor documentation due to the responsiveness and direct knowledge of the lead beamline scientist of how and where the information is stored,
- Good housekeeping in all areas including mezzanine.

The team also notes that the Instrument Readiness Plan was both signed and dated by the responsible signatories in response to a previous suggestion, and the added dates should enhance the quality and traceability of this record. Also, the website that provides access to the various documents necessary to complete the review was prepared several days in advance of the review and greatly aided the review process. The team enjoyed and deeply appreciated working with counterparts that worked diligently, thoughtfully, and carefully to respond to our questions and concerns. The NSLS-II staff worked hard to fulfill our requests, locate documents, provide additional information as quickly as possible. The team is very grateful for their assistance.

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 18-ID Full Field X-ray Imaging (FXI) beamline and front end 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 the beamline and front end. The plan is detailed in the following document:

- NSLSII-18ID-PLN-003, *Instrument Readiness Plan (IRP) for the NSLS-II 18-ID Beamline and Front End*

The scope of the review included the 18-ID beamline and end station along with front-end components and configuration not previously reviewed. The damping wiggler source for 18-ID was reviewed in December 2014 as part of the original NSLS-II project as part of a limited-scope readiness review and has been in use since. The installation of the remaining front-end components was completed in August 2017 and included the ratchet wall collimator. The completed front end was subsequently reviewed in a previous IRR conducted on 29 August 2017.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 encapsulated in the Instrument Readiness Plan. The readiness plan is organized into three 'pillars' of readiness: 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 plan for the beamline and front end; PowerPoint overviews of the beamline and front end 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 18 October 2017 and for a half-day on 25 October 2017. 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

Next, the team conducted interviews with selected NSLS-II staff members and 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. 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. 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. Definitions

1.3.1. Pre-Start Finding:

A condition, deficiency, or performance issue identified in the IRR report that has safety significance or has a substantive impact on any of the attributes, performance requirements, or criteria used to determine startup readiness. Pre-start findings are required to be resolved prior to proceeding with an ARR, commissioning or operations.

1.3.2. Post-Start Finding:

A condition, deficiency, or performance issue identified in the IRR report that has no safety significance and does not have a substantive impact on any of the attributes, performance requirements, or criteria used to determine startup readiness.

1.3.3. Observation:

Areas, components, or processes that were reviewed by the IRR team. Observations constitute objective evidence that may lead to opportunities for improvement, noteworthy practices, pre- or post-start findings. When the observation leads to none of these, it is cited merely in the **Observations** section of the report.

1.3.4. Noteworthy Practices:

Performance that exceeds expectations in terms of efficiency and/or effectiveness and provides a model for others to follow. A noteworthy practice is a positive condition or strength.

1.3.5. Opportunities for Improvement and Recommendations:

A suggested means of improving an activity or fulfilling the intent of a requirement.

1.4. 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: Experimental Protection System, Personnel Protection System

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

- Raymond Fliller, NSLS-II
  Review Areas: Radiological Controls, Shielding, Radiation Survey Plans, Unreviewed Safety Issues

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

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

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

- Ryan Tappero, NSLS-II
  Review Areas: Commissioning Plan, Design, Radiological Controls, Configuration Control, Management

2. FINDINGS/CONCLUSIONS

2.1. Pillar I – Documentation

2.1.1. Pre-Start Finding

2.1.1.1. None.

2.1.2. Post-Start Findings

2.1.2.1. None.

2.1.3. Observations

2.1.3.1. Inspection of DI Water Header Flow Instrumentation tags revealed disagreement with information on sheet 2 of drawing PD-FXI-UT-1500. Upon further investigation, it was discovered the drawing had omitted the usual tag ID for these flow components and that the numbers had been assigned to other components unrelated to the flow instruments. The misidentified components include a GN_2 valve and two pressure gauges on the Haskris chiller system. Further review revealed that all other flow components on the drawing were correctly tagged and identified. This misidentification appears to be an isolated instance, and beamline utilities personnel were very helpful and forthcoming in identifying the issue. Furthermore, drawing generally showed excellent quality and pictorial representation of most piping components, allowing simple and fast verification of the actual installation versus the design as captured in the drawing.

2.1.3.2. During the traveler review, the following travelers were sampled and found to be incomplete:

- Beamline ODH Installation and Acceptance Testing:18ID Hutch:A
- Hutch Acceptance Testing Part:BL:FXI Hutch 17-ID-B
- FXI Shield Beam Pipe Acceptance Testing Part:PD-FXI-BL-1090
- SR FE-SLT-3650-SLT (leak test forms)

The deficiencies included the following:

a. Information not completed with date, data, or NA.

b. Not all cross-outs were in red, and, in some cases, not initialed.

c. Relevant part/beamline identification information is recorded on the traveler front page, but not on all subsequent pages.

These deficiencies were corrected by the end of the review. (Compare with **Post-Start 3**, ¶ 2.2.2.3.)

2.1.3.3. Other travelers reviewed:
- NSLS-II Area Radiation Monitor PPS Test Att: D NSLS-II Beamline (FOE) Area Radiation Monitor Checklist
- FXI Bremsstrahlung Shielding Part: PD-FXI-BL-1042 and Attachments (mechanical survey results for primary brem. stop, drawing, Toyama acceptance test report)
- SR FF-SLT-3600-SLT, including assembly records for 3602 and 3600

2.1.3.4. ODH components, installation, and travelers were reviewed.

2.1.3.5. Beamline vacuum equipment traveler reviewed.

2.1.3.6. Beryllium window material certification and test certification reviewed. All required information was provided by the vendor.

2.1.3.7. Cryocooler installation traveler and beamline LN_2 acceptance test and pressure test documentation was reviewed.

2.1.3.8. Reviewed TOSS report. No issues found.

2.1.3.9. Observed that NEPA evaluation was completed and results reported.

2.1.3.10. Observed that all ATS actions for 18-ID are closed. These items include the following:
- 8053.40.1
- 8053.40.2
- 8053.40.3
- 8053.40.4

2.1.4. Noteworthy Practices

2.1.4.1. Design review and vendor documentation was requested and reviewed with lead beamline scientist. The scientist had direct knowledge of how and where the information is stored and was able to produce most documents requested quickly.

2.1.4.2. Beamline utilities personnel maintain the notable practice that they will not connect any equipment to mechanical utilities unless the testing record is provided to them. Thus, they were able to produce all vendor pressure test results for all internally pressurized components.

2.1.4.3. All readiness items on the Instrument Readiness Plan are both signed and dated. This practice was recommended to management prior to this review, and the practice has been implemented for this beamline.

2.1.5. Opportunities for Improvement and Recommendations

2.1.5.1. NSLS-II Insertion Devices and Front-End Commissioning Sequence (PS-C-ASD-PRC-166) appears to be overly complicated, including many

steps that are not strictly necessary for commissioning of the ID or front end. Example steps include 6.1.2, 6.1.3, 6.1.7, 6.1.8, 6.1.9, and 6.1.11. These steps, though important for functioning of the ring, are not necessary for proving that the insertion device operates at a basic level. There may be other steps that should also be considered for removal from the commissioning procedure.

2.1.5.2. Recommend that NSLS-II consider the necessity and usefulness of the Phase 3 radiation survey in the NSLS-II Insertion Devices and Front Ends Radiation Survey Plan (PS-C-ESH-PRC-061). This phase of the radiation survey does not appear to be directly relevant to the beamline itself, but rather is more relevant to the accelerator as a whole. The proposition that the addition of the beamline changes the effective shielding of the accelerator ring is likely true but difficult to quantify, and the method of dumping beam near the front end is imprecise. The effects of this beam loss do not lend themselves to direct comparison with FLUKA calculations. In addition, the phase 3 survey is time-consuming and may unnecessarily delay beamline commissioning.

2.1.5.3. Consider separating pre- and post-start items for the beamline from those for the front end. In this manner, if there are any pre-starts for the beamline itself, but not for the front end, the front-end may proceed with commissioning while pre-starts for the beamline are resolved.

2.1.5.4. Leak/pressure test forms for front-end utilities were not filled out completely with important information used to determine the required test pressure. This is a recurring issue, and it is recommended that action be taken to correct it. A knowledgeable and/or properly trained authorized inspector acting as a third party should be able to fill out the form properly. Note that because the actual test pressure is included in the record and meets the requirements of the ASME B31.3 code, it remains as an opportunity for improvement and has not been elevated to a finding.

2.1.5.5. Travelers do not reference evaluation criteria, e.g., requirement, specifications, “information only” for the recorded parameters. Consider indicating requirements or referencing relevant specifications.

2.1.5.6. Travelers typically contain multiple attachments; some of those are specific to the traveler while others are relevant to multiple travelers. Consider tracing and/or mapping traveler’s attachments and the supplemental documentation.

2.2. Pillar II – Hardware and Physical Plant

2.2.1. Pre-Start Findings

2.2.1.1. ***Pre-Start 1 Condition:*** Initial observation of the Radiation Safety Checklist components found that a number of these components were missing the required photos documenting the configuration. These photos were eventually added by the end of the review. However, the photo documenting the collimator mirror did not show the hard stops for this component as required.

- ***Pre-Start 1 Finding:*** The Radiation Safety Checklist (NSLSII-R-XFD-CHK-002) indicates that the hard stops for the collimator mirror should be verified using the photo. However, the photo does not show the stops.

2.2.1.2. ***Pre-Start 2 Condition:*** Inspection of the testing procedure for the Beamline Equipment Protection System (EPS) revealed that several insertable flags in the FOE were missing from the Beamline EPS Test Checklist (PS-R-XFD-EPS-CHK-001).

- ***Pre-Start 2 Finding:*** The Beamline EPS Test Checklist is missing the test results for the beamline fluorescent screens XF:18IDA-OP{WPFS:1-Ax:Y1} and XF:18IDA-OP{PMFS:1-Ax:Y1}.

2.2.1.3. ***Pre-Start 3 Condition:*** The collimator mirror in the FOE is a radiation safety component whose motion is required to be constrained by a pair of hard stops (see Fig. 1). Analysis of the radiation safety considerations assume that the motion of the mirror will be fully constrained by the hard stops and no further analysis of the potential missteering due to failure of the hard stops to constrain the motion of the mirror was completed. Furthermore, no engineering analysis of the ability of the hard stops to constrain the motion of the mirror was produced by NSLS-II despite concerns by the team that the hard stops did not appear to be adequately robust and might shift in a manner that would not be immediately apparent, leading to potential beam missteers that lie outside of the scope of the present analysis.

- ***Pre-Start 3 Finding:*** Because the collimator mirror has been declared to be a radiation-safety component, the present constraints on the motion of the mirror are not sufficient for safe operation. After review by the IRR team, the commissioning plan (NSLSII-18ID-PLN-004) was modified by the lead beamline scientist to provide for

constraints on the commissioning activities and the motion of the mirror based on the beam current delivered to the beamline.

The team has no pre-start finding for the proposed mode of operation as outlined in the commissioning plan. **However**, to operate outside of the constraints outlined in the commissioning plan, specifically, *NSLSII-18ID-PLN-004, Rev. 2, 24 October 2017*, **will require further evaluation by this IRR team.**

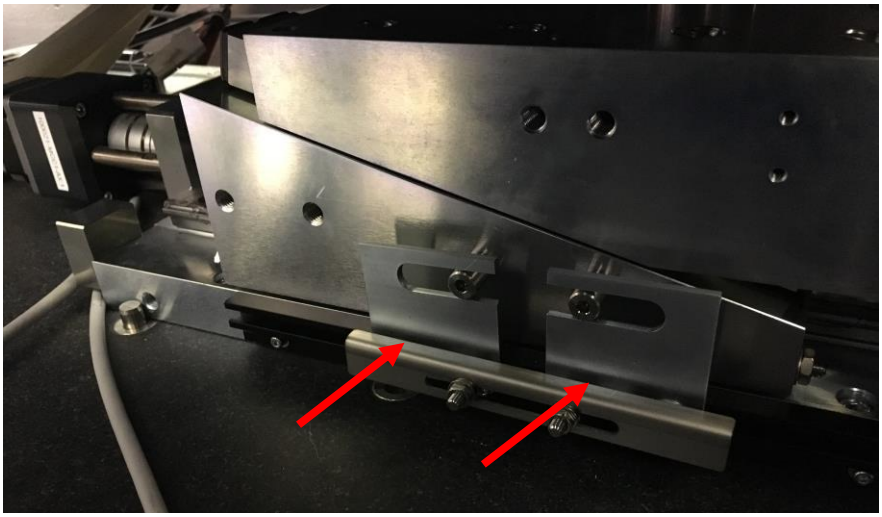

Figure 1: Hard stops for collimating mirror shown with arrows.

2.2.2. Post-Start Findings

2.2.2.1. ***Post-Start 1 Condition:*** The Radiation Safety Committee (RSC) memo of 4 October 2017 did not include reference to the discussion of the pink beam stop clearance. This clearance was less than the recommended value, but deemed acceptable by the Committee.

- ***Post-Start 1 Finding:*** The RSC memo of 4 October 2017 does not include reference to the discussion of the exception to the ray-trace procedure for the allowed clearance of the maximum synchrotron fan to the pink beam stop: in particular, the clearance of the extremal ray produced by the collimator mirror motion permitted by the mirror hard stops.

2.2.2.2. ***Post-Start 2 Condition:*** Inspection of the commissioning readiness traveler BL-FXI-004, Rev. 4 revealed missing documentation that could not be located.

- ***Post-Start 2 Finding:*** On the FXI Beamline Commissioning Readiness traveler, BL-FXI-004, Rev. A, in step 30, the NSLSII-18ID-CHK-001 reference was crossed out and replaced with NSLSII-R-XDF-CHK-22. Form NSLSII-R-XDF-CHK-022 was not found. Radiation Interlock Checklist NSLSII-18D-CHK-001 is on file.

2.2.2.3. ***Post-Start 3 Condition:*** During the traveler review, several travelers were sampled and found to have deficiencies ranging from incomplete information to not all cross-outs being marked in red and initialed.

- ***Post-Start 3 Finding:*** The following travelers were sampled and found to have information not completed with date, data, or NA at the indicated steps:

  - BL-SRVY-001 Rev. A, step 50B
  - BL-VA-001 Rev. B, pg. 1, step 20D
  - BL-SRVY-001 Rev. A, step 60 and 70

  In addition, the following travelers were found not to have all cross-outs in red and, in some cases, were not properly initialed at the steps indicated:

  - BL-FXI-003 Rev. A, step 10
  - BL-SRVY-001 Rev. A, step 50B

2.2.2.4. ***Post-Start 4 Condition:*** Inconsistent or incomplete labeling of hardware was observed.

- ***Post-Start 4 Finding:*** Front End Shutter ID Plates 3600 and 3650 are missing.

2.2.2.5. ***Post-Start Condition 5:*** Inspection of photos being used for configuration/guidance revealed that they do not meet the minimum requirements for an Operator Aid as defined in the SBMS Subject Area. Furthermore, some photos were missing, and it was not always clear what photos were required.

- ***Post-Start Finding 5:*** Photos do not meet the minimum requirements for an Operator Aid, as expected, including revision designations/dates, and evidence of staff review and approval.

2.2.2.6. ***Post-Start Condition 6:*** A temperature controller had failed during the evening before the last day of the review. Manual setting of the controller was possible, but a replacement was required.

- ***Post-Start Finding 6:*** A faulty temperature controller required replacement.

2.2.2.7. ***Post-Start Condition 7:*** The search-and-secure procedure for 18-ID was walked-through. The walkthrough indicated that not all parts of the hutch were visible using the mirrors mounted in the hutches as required for clearing the hutch of personnel before commencing beam activity.

- ***Post-Start Finding 7:*** Walkthrough of the search-and-secure procedure for 18-ID indicated that not all parts of the hutches were visible using the mounted mirrors.

2.2.2.8. ***Post-Start Condition 8:*** In hutch A, several terminal strips were found to be missing covers.

- ***Post-Start Finding 8:*** Terminal strips were found to be missing covers in hutch A.

2.2.3. Observations

2.2.3.1. Test reports for both the EPS and PPS were examined. No deficiencies or issues were found.

2.2.3.2. PPS function was observed during review and no functional issues noted. Doors can sometimes “bounce”, and a PPS reset is permitted by the user in this event. This was tested and found to operate as expected.

2.2.3.3. Observed dual connectors for components requiring radiation hardness. The dual cables appear to be redundant, and labels were applied to each cable to distinguish them.

2.2.3.4. Verified that appropriate configuration control labels were applied to upstream beamline elements necessary for radiation modeling and machine protection.

2.2.3.5. All labyrinth doors observed to be closed and properly tagged for configuration control.

2.2.3.6. Observed sawtooth oscillation in slit motor display caused by graphs auto-ranging and a LSB flicker. Solved by turning off auto-ranging.

2.2.3.7. Slit controls observed to be operating properly for everything except vertical slits in one instance. This was debugged immediately and a PV typo in a gateway was found and corrected.

2.2.3.8. The slit motion controls have been designed with a remote-select process variable that must be set by the accelerator control room before

the slits can be moved by the CSS screen. The process variable works proper, but, at the start of the day, the operators had not yet added the required graphical user interface (GUI) to their control screens (see recommendation 2.2.5.1).

2.2.3.9. Cryocooler installation traveler and beamline LN_2 acceptance test and pressure test documentation reviewed.

2.2.3.10. Inspected low-voltage cable design and installation. No issues observed.

2.2.3.11. Inspected as-built installation with one-line configurations. No issues observed.

2.2.3.12. Inspected high-voltage design and installation. No issues observed.

2.2.3.13. All electrical installation inspected complies with NRTL requirements.

2.2.3.14. All conduits inspected are properly installed.

2.2.3.15. All terminations above 50 V inspected were properly guarded.

2.2.3.16. Stands, racks, and cable tray inspected were properly bonded.

2.2.3.17. Racks and cables inspected were properly labelled.

2.2.3.18. All hazards appear to be properly labelled.

2.2.4. Noteworthy Practices

2.2.4.1. Observed excellent housekeeping in all areas including mezzanine.

2.2.4.2. Observed very good cable management throughout beamline.

2.2.5. Opportunities for Improvement and Recommendations

2.2.5.1. In preparation for commissioning, it has been found that there are often issues with the front-end slit motion. These problems break down into three areas:

1. The motor controllers or the motor themselves,
2. The CSS controls, and
3. The control of the slits at the beamline.

Because the slits are one of the front-end items that beamline staff often wish to adjust during conditioning, and issues in slit control are often encountered, requiring additional time to resolve, NSLS-II should consider adding control of the slits to the beamline readiness criteria. Though not strictly necessary that the beamline control the slits, given the large number of beamlines, it may be advisable to establish control from both the control room and the beamline.

2.2.5.2. Within the accelerator, all penetrations between enclosures (i.e., LINAC/Booster or P2/Booster), shielding components appear on both checklists. Consider placing references on checklists for only one of the enclosures to enhance efficiency and reduce inconsistencies.

2.2.5.3. Shielded transport line pump enclosures (18ID-SPE-01, 18ID-SPE-02, 18ID-SPE-03) have lids that are secured in place by releasable clasps. Consider removing the lifting eyes from these lids.

2.2.5.4. On the roof of hutch A, fire alarm wiring is run through flexible, non-metallic conduit that passed through the high-voltage section of the cable tray. Consider passing conduit through low-voltage section or tray or circumventing tray altogether.

2.2.5.5. Temporary tags and labels use for installation purposes are left on equipment. Consider removing these tags once work is complete or replace with permanent tags as required.

Figure 2: Note loose label on radiation safety component SR-SHLD-18ID{ZCE}.

2.2.5.6. Observed loose label for a radiation safety component. Recommend inspecting labels to ensure that they are securely affixed to equipment (see Fig. 2).

2.3. Pillar III – Personnel

2.3.1. Pre-Start Findings

2.3.1.1. None.

2.3.2. Post-Start Findings

2.3.2.1. None.

2.3.3. Observations

2.3.3.1. Observed that all beamline 18-ID staff and roles identified (lead scientist, authorized beamline staff, and beamline support staff).

2.3.3.2. All JTAs assigned according to procedure NSLSII-TRN-WIN-001.

2.3.3.3. All training for required personnel completed.

2.3.3.4. Procedure NSLSII-TRN-WIN-001, describing the guidelines for the minimum number of trained and qualified beamline staff, is in draft status.

2.3.4. Noteworthy Practices

2.3.4.1. None.

2.3.5. Opportunities for Improvement and Recommendations

2.3.5.1. None.

3. READINESS DETERMINATION

The team has agreed on two pre-start findings that must be resolved prior to commissioning of the 18-ID beamline. These findings concern a photograph that fails to show the hard stops for the collimator mirror as required by the radiation safety checklist and missing test results for several insertable beamline flags from the EPS test checklist.

In addition, it must be noted that because of concerns about the potential for misconfiguration of the collimator mirror, a radiation safety component, the commissioning plan (NSLSII-18ID-PLN-004, Rev. 2, 24 October 2017) details constraints placed on the motion of the mirror dependent upon the beam current delivered to the beamline. Should the beamline wish to operate outside of the constraints detailed in the above referenced plan, **further evaluation by the IRR team will be required before authorization may be granted.**

Authorization to begin beamline technical commissioning of 18-ID must await closure of the pre-start items referenced above.

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
Pre-Start 1	Pillar II – Installation: Radiation Safety Components: Configuration Control	***Pre-Start 1 Finding:*** The Radiation Safety Checklist (NSLSII-R-XFD-CHK-002) indicates that the hard stops for the collimator mirror should be verified using the photo. However, the photo does not show the stops.
Pre-Start 2	Pillar II – Installation: Equipment Protection System (EPS) Interlocks	***Pre-Start 2 Finding:*** The Beamline EPS Test Checklist is missing the test results for the beamline fluorescent screens XF:18IDA-OP{WPFS:1-Ax:Y1} and XF:18IDA-OP{PMFS:1-Ax:Y1}.
Pre-Start 3	Pillar II – Installation: Radiation Safety Components: Configuration Control	***Pre-Start 3 Finding:*** Because the collimator mirror has been declared to be a radiation-safety component, the present constraints on the motion of the mirror are not sufficient for safe operation. After review by the IRR team, the commissioning plan (NSLSII-18ID-PLN-004) was modified by the lead beamline scientist to provide for constraints on the commissioning activities and the motion of the mirror based on the beam current delivered to the beamline. The team has no pre-start finding for the proposed mode of operation as outlined in the commissioning plan. **However**, to operate outside of the constraints outlined in the commissioning plan, specifically, *NSLSII-18ID-PLN-004, Rev. 2, 24 October 2017*, **will require further evaluation by this IRR team.**
Post-Start 1	Pillar I – Documentation: Secondary Radiation Scatter Analysis	***Post-Start 1 Finding:*** The RSC memo of 4 October 2017 does not include reference to the discussion of the exception to the ray-trace procedure for the allowed clearance of the maximum synchrotron fan to the pink beam stop: in particular, the clearance of the extremal ray produced by the collimator mirror motion permitted by the mirror hard stops.
Post-Start 2	Pillar II – Documentation: Other FE Components, Photon Transport Components, Optics and Diagnostics	***Post-Start 2 Finding:*** On the FXI Beamline Commissioning Readiness traveler, BL-FXI-004, Rev. A, in step 30, the NSLSII-18ID-CHK-001 reference was crossed out and replaced with NSLSII-R-XDF-CHK-22. Form NSLSII-R-XDF-CHK-022 was not found. Radiation Interlock Checklist NSLSII-18D-CHK-001 is on file.

Post-Start 3	Pillar II – Installation: Other FE Components, Photon Transport Components, Optics and Diagnostics	***Post-Start 3 Finding:*** The following travelers were sampled and found to have information not completed with date, data, or NA at the indicated steps: - BL-SRVY-001 Rev. A, step 50B - BL-VA-001 Rev. B, pg. 1, step 20D - BL-SRVY-001 Rev. A, step 60 and 70 In addition, the following travelers were found not to have all cross-outs in red and, in some cases, were not properly initialed at the steps indicated: - BL-FXI-003 Rev. A, step 10 - BL-SRVY-001 Rev. A, step 50B
Post-Start 4	Pillar II – Installation: Radiation Safety Components: Configuration Control	***Post-Start 4 Finding:*** Front End Shutter ID Plates 3600 and 3650 are missing.
Post-Start 5	Pillar II – Installation: Radiation Safety Components: Configuration Control	***Post-Start Finding 5:*** Photos do not meet the minimum requirements for an Operator Aid, as expected, including revision designations/dates, and evidence of staff review and approval.
Post-Start 6	Pillar II – Installation: Controls	***Post-Start Finding 6:*** A faulty temperature controller required replacement.
Post-Start 7	Pillar II – Installation: Personnel Protection System (PPS) Interlocks: Installed and Certified	***Post-Start Finding 7:*** Walkthrough of the search-and-secure procedure for 18-ID indicated that not all parts of the hutches were visible using the mounted mirrors.
Post-Start 8	Pillar II – Installation: Electrical Power	***Post-Start Finding 8:*** Terminal strips were found to be missing covers in hutch A.

APPENDIX A
CHARGE AND REVIEW TEAM

OCTOBER 11, 2017

NSLS II IRR READINESS TEAMS: FXI BEAMLINE

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

Ray Fliller
- Radiological controls; shielding; radiation survey plans; USI

Chuck Gortakowski
- QA; travelers; training; verify action closure

Lee Hammons
- Team leader

Thomas Nehring
- Electrical power distribution; EEI

Alena Stavitski
- QA; travelers; training; verify action closure

Ryan Tappero
- Commissioning plan; design; radiological controls; configuration control; management

Readiness Preparation Team

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
De Silva, Chanaka
Doom, Lewis
Fliller, Raymond
Fries, Gregory
Ganetis, George
Gofron, Kazimierz
Gosman, John
Haas, Edwin
Heneveld, Brian
Hetzel, Charles
LaMarra, Steven
Lee, Robert
Lee, Wah-Keat
Lein, Bruce
Lienhard, Lukas
Loftus, Mike
McDonald, Tom
McSweeney, Sean
Moss, Steven
Padrazo, Danny
Rank, James
Rubino, Kristen
Shaftan, Timur
Sharma, Sushil
Shoemaker-Skokov, Ashley
Stebbins, Christopher
Stiegler, Lori
Tanabe, Toshiya
Todd, Robert
Wang, Guimei
Xu, Huijuan
Zhong, Zhong
Zipper, Joseph
Zschack, Paul

APPENDIX B
REVIEW AGENDA

MEETING DATES: OCTOBER 18 & 25, 2017

NSLS II IRR: FXI BEAMLINE

ACKERMAN

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

Day 01; October 18
LOB5, Rm. 156

08:30 – 09:00	Review Team Executive Session	Review Team
09:00 – 09:30	18-ID FE Overview	All
09:30 – 10:15	FXI Overview	All
10:15 – 10:30	Break	All
10:30 – 12:00	Tour	Review Team Adams, Amundsen, Bassan, Doom, Wah-Keat, Ganetis, Gofron, Gosman, Xu. (All are welcome)
12:00 – 1:00	Lunch (no host)	All
1:00 – 5:00	Discussion, document review, interviews	Review Team NSLS II staff as needed

Day 02; October 25
LOB5, Rm. 156

1:00 – 1:30	Review Team Executive Session	Review Team
1:30 – 3:30	Discussion, document review, interviews	Review Team NSLS II
3:30 – 4:30	Review Team Executive Session	Review Team
4:30 – 5:00	Close-Out with preliminary findings	All

APPENDIX C
READINESS PLAN FOR 18-ID

	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 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	W. Lee Lead Beamline Scientist	Develop the presentation and document described	Beamline: • Presentation • Functional Description Document	Signature (Beamline): Walter 10/11/17
		G. Fries Accelerator Division Liaison Engineer	• Develop the presentation described	FE: • Presentation	Signature (FE): 10/11/17
	Beamline & FE Design Beamline and FE components are designed in accordance with PS-QAP-0412, *Design Reviews* and PS-C-QAS-PRC-010, *Engineering Design by Others*.	W. Lee Lead Beamline Scientist	Complete Engineering Design Reviews for the Beamline and FE that address therma management, mechanical support, configuration control, and vacuum	Beamline: • Internal and contractor supplied design review documents and reports	Signature (Beamline): Walter 10/11/17
		S. Sharma Mechanical Engineering Group Leader		FE: • Requirements, Specifications, and Interface report (RSI) Internal and contractor supplied design review documents	Signature (FE): S. Sharma 10/6/17

	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*.	W. Lee 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): Walter 10/12/17
		C. Amundsen Mechanical Engineer	• Complete requirements analysis and design of radiation safety components for the FE	FE: • Internal design review documents • RSC Report	Signature (FE): *Reviewed in August 2017 IRR
	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: 10/17/17
	Ray Traces Bremsstrahlung and Synchrotron Ray Traces generated in accordance with PS-C-XFD-PRC-008, *Synchrotron and Bremsstrahlung Ray Trace Procedure*.	W. Lee Lead Beamline Scientist	• Prepare the Ray Traces for the Beamline	Beamline: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (Beamline): Walter 10/11/17
		C. Amundsen Mechanical Engineer	• Verify the Ray Traces for the Front End are sufficient	FE: • Approved Primary Bremsstrahlung Ray Traces • Approved Maximum Synchrotron Ray Traces	Signature (FE): *Reviewed in August 2017 IRR

*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: 10/5/17
	National Environmental Protection Act (NEPA) Evaluation NEPA requirements evaluation completed.	L. Stiegler ESH Operations Group Leader	• Complete a NEPA evaluation	• NEPA Evaluation Report	Signature: 10/5/17
	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 and FE; including temporary systems	• SAD and ASE USI screenings/evaluations • Applicable waivers	Signature (Beamline): 10/11/13 Signature (FE): 10/11/13

	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): 10/12/17
		E. Cheswick QA Engineer	• ATS action items for the FE are satisfied. • ATS action items from previous IRRs are evaluated for impact to the instrument	FE: • ATS System	Signature (FE): 10/12/17
	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	• 18-ID Radiological Interlock Test Checklist • Search and Secure Sketch • Damping Wiggler LOTO Procedures (PS-C-ASD-PRC-122 and PS-C-ASD-PRC-177) • Cryocooler Operations (NSLSII-ROS-PRC_001)	Signature: 10/11/17

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	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 to address the task sequence required for technical commissioning (safe photon transport).	W. Lee Lead Beamline Scientist	• Prepare a Beamline Commissioning Plan to define technical objectives and operational readiness requirements	Beamline: • Approved Beamline Commissioning Plan	Signature (Beamline): 10/12/17
		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 FE	FE: • NSLS-II ID and Front End Commissioning Sequence (PS-C-ASD-PRC-166)	Signature (FE): *Reviewed in August 2017 IRR
	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.	S. Chitra Health Physics	• Prepare the Radiation Survey Procedure for the Beamline • Obtain RSC review of the procedure	• Approved Beamline Radiation Survey Procedure	Signature (Beamline): 10/11/2017
		M. Benmerrouche Radiation Physicist	• Verify that the NSLS-II Front End Radiation Survey Plan (PS-C-ESH-PRC-061) adequately covers commissioning for the FE	• NSLS-II Insertion Devices and Front End Radiation Survey Plan (PS-C-ESH-PRC-061)	Signature (FE): 10/11/2017

	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.	W. Lee Lead Beamline Scientist	• Complete submission and pursue approval of an Experiment Safety Review through use of the BNL electronic system	• Approved BNL ESR	Signature: 10/11/17
	Proposal Allocation Safety & Scheduling (PASS) The instrument is active within PASS with approvals to proceed with Technical Commissioning.	W. Lee 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: 10/11/17

*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.	W. Lee Lead Beamline Scientist	• Generate and execute Traveler	Beamline: • Completed Traveler	Signature (Beamline): 10/17/17
		C. Amundsen Mechanical Engineer	• Complete partially executed Traveler	FE: • Completed Traveler	Signature (FE): 10/11/17
		L. Doom Accelerator Coordination	• Generate and execute Top-Off Traveler	Completed Traveler	Signature: 10/5/2017
	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.*	W. Lee Lead Beamline Scientist	• Develop Radiation Safety Component Checklist	Beamline: • Approved beamline specific Radiation Safety Component Checklist w/ RSC approval	Signature (Beamline): 10/11/17
		L. Doom Accelerator Coordination	• Verify that the existing checklist adequately covers the subject FE	FE: • Approved Storage Ring Radiation Safety Component Checklist Template	Signature (FE): *Reviewed in August 2017 IRR

	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: 10/16/2017
	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: 10/11/17
	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: 10/4/17
	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: 10/4/17

*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.*	L. Lienhard Beamline Engineer	• Generate and execute Traveler for inspection	• Completed Traveler	Signature: 10/6/2017
	Electrical Power SBMS electrical power distribution requirements are satisfied. SBMS Electrical Equipment Inspection (EEI) requirements are satisfied.	A. Boerner Electrical Distribution Engineer	• Approved one-line drawings • System electrical inspection • EEI inspection	• Approved AC Power one–line drawings • EEI database entries	Signature: 10/10/17
	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 (FE): 10/16/17
		W. Lee Lead Beamline Scientist			Signature (Beamline): 10/17/17

	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.	W. Lee Lead Beamline Scientist	• Generate and execute Traveler • Complete acceptance inspections	Beamline: • Completed Traveler • Acceptance inspection documentation, as needed	Signature (Beamline): 10/17/17
		C. Amundsen Mechanical Engineer	• Generate traveler and drawing • Execute Traveler • Perform pressure test	FE: • Completed Traveler • System pressure testing reports	Signature (FE): 10/11/17
	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): 10/10/17
	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: • Test Report Phase 2 Installation	Signature (FE): 10/11/17

*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.	H. Xu/K. Gofron Controls Engineer	• Test system performance • Complete integral testing	Beamline: • Performance and integral testing documentation	Signature (Beamline): 10/12/17
		D. Padrazo Instrumentation Group Leader	• Test system performance • Complete integral testing	FE: • Performance and integral testing checklist	Signature (FE): 10/12/17
	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): 10/11/17
		C. Hetzel Vacuum Group Leader	• Generate and execute Top Level Traveler • Identify overpressure devices • Test system • performance	FE: • Completed Top Level Traveler • Test Report	Signature (FE): *Reviewed in August 2017 IRR

	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: 10/16/17
	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: 10/17/17
	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: 10/17/17
	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 commissioning	B. Lein Training Group Leader	• Train Operators	• BTMS record	Signature: 10/11/17

* Readiness Certification	**W. Lee - Lead Beamline Scientist**	**Signature:** 10/17/17
* Readiness Certification	**S. Sharma - Mechanical Engineering Group Leader**	**Signature** 10/18/17

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

	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 18-ID 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 (Front End) No pre-start findings associated with the FE 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 18-ID Beamline IRR pre-start findings are complete.	J. Adams IRR Technical Authority (Beamline)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Complete (Front End) All actions associated with the FE IRR pre-start findings are complete.	T. Shaftan IRR Technical Authority (Front End)	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (Beamline) All actions associated with the 18-ID Beamline IRR pre-start findings have been verified complete.	R. Lee ESH Manager	• Pertinent closure evidence	Signature:
	Pre-Start Actions Verified (Front End) All actions associated with the FE 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 18-ID Beamline IRR pre-start findings have been satisfactorily complete.	M. Hauptmann Independent Verifier	• Pertinent closure evidence	Signature:
	Pre-Start Actions Independently Verified (Front End) Actions associated with the FE 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
IRR PRELIMINARY REPORT

NSLS II BROOKHAVEN NATIONAL LABORATORY	Prepared by: Lee Hammons LH 10/26/2017

TITLE:

IRR Preliminary Report
Cell 18 Full Field Imaging Beamline (FXI)

REVIEWERS:

M. Cubillo, A. Etkin, R. Farnsworth, R. Fliller, C. Gortakowski, L. Hammons, T. Nehring, R. Tappero, A. Stavitski

DISTRIBUTION:

Reviewers listed above.

A. Ackerman, J. Adams, M. Bebon, E. Johnson, J. Hill, R. Lee, W. Lee, S. McSweeney, K. Rubino, T. Shaftan, Q. Shen, G. Wang, P. Zschack

The IRR Team has completed the on-site readiness review and document analysis for the subject instrument. This report provides preliminary status for the pre-start findings identified.

The Review Team identified no pre-start findings for the Cell 18 front end.

The Review Team identified three pre-start findings for the Cell 18 beamline:

- **Finding:** The Radiation Safety Checklist indicates that the hard stops for the collimating mirror should be verified using the attached photo; however, the photo does not show the hard stops.

- **Finding:** The testing report for the EPS does not include several insertable flags in the First Optics Enclosure.

- **Finding:** The present constraints on the motion of the collimating mirror are not sufficient for safe operation because the mirror has been declared a radiation safety component. After review by the IRR team, the commissioning plan (NSLSII-18ID-PLN-004) was modified by the lead beamline scientist to provide for constraints on the commissioning activities and the motion of the mirror based on the beam current delivered to the beamline.

  The team has no pre-start finding for the proposed mode of operation as outlined in the commissioning plan. **However**, to operate outside of the constraints outlined in the commissioning plan, specifically, *NSLSII-18ID-PLN-004, Rev. 2, 24 October 2017*, **will require further evaluation by this IRR team**.

Authorization to begin beamline technical commissioning of Cell 18 (FXI) must wait for closure of the first two pre-start items listed above.

Post-start findings and observations will be detailed in a final IRR report.

Page 1 of 1