NSLS-II NEXT BEAMLINE 04-ID
COMMISSIONING PLAN

JUNE 10, 2016

NX-C-XFD-ISR-PLN-001

REV. 1

NSLS-II NEXT BEAMLINE 04-ID
COMMISSIONING PLAN

JUNE 10, 2016

PREPARED BY:

6/10/2016

X Christie Nelson

Christie Nelson
ISR Lead Beamline Scientist
Signed by: Nelson, Christie

APPROVED BY:

6/16/2016

X

Paul Zschack
Photon Science Division Director
Signed by: Zschack, Paul

REVISION HISTORY

REVISION	DESCRIPTION	DATE
1	First Issue	June 10, 2016

Acronyms

BNL	Brookhaven National Laboratory
ESH	Environment, Safety and Health
ESR	Experiment Safety Review
FE	Front End
FLUKA	Fluktuierende Kaskade (Monte Carlo simulation software)
ID	Insertion Device
IRR	Instrument Readiness Review
ISR	In-Situ and Resonant X-ray Studies
mA	milli-Ampere
NSLS-II	National Synchrotron Light Source II
PASS	Proposal, Allocation, Safety and Scheduling
PPS	Personnel Protection System
PSD	Photon Science Division
SAF	Safety Approval Form
TCP	Technical Commissioning Plan

Table of Contents

1. INTRODUCTION

This plan outlines the actions needed to commission the NSLS-II NEXT 4-ID beamline from the accelerator enclosure ratchet wall to the end station. Once the readiness process is complete, and authorization to begin commissioning the beamline is received, the technical commissioning will proceed, initially hand in hand with a radiation safety commissioning, until the beamline is deemed to be radiation safe in standard x-ray operations. In the latter stages of technical commissioning, the main optical elements of the beamline are optimized for user operations, and finally the end-stations are also commissioned. There are several processes established to manage the risks associated with this task, which are outlined below.

The scope of this plan includes managing specific commissioning activities for the beamlines, reviewing requirements for equipment not needed for commissioning, but planned for operations, and the basis for transitioning to operations. Technical commissioning of the FEs and IDs is managed separately from the beamline and has already been completed.

2. SHIELDING

Ray tracing and computer modeling (FLUKA) indicate that 4-ID is shielded for the maximum planned stored electron beam current of 500 mA. The primary Gas Bremsstrahlung ray traces have been completed in accordance with *Synchrotron and Bremsstrahlung Ray Trace Procedure* (PS-C-XFD-PRC-008) and *Insertion Device Front End Ray Tracing Procedure* (PS-C-ASD-PRC-147) and result in two Bremsstrahlung collimators and a Bremsstrahlung stop within the 4-ID-A hutch. A single Secondary Gas Bremsstrahlung shield was designed following NSLS-II guidelines. The scattering of Bremsstrahlung has been modeled using FLUKA, which showed that the secondary shield is adequate at 500 mA beam current. The summary of these simulations including the simulation of the monochromatic beam containment in beam transport and endstation enclosures are provided in *4-ID ISR Beamline Radiation Shielding Analysis* (Technote #216).

3. BEAMLINE COMMISSIONING

The commissioning of the ISR beamline and its transition to operations begins with the IRR. This will be followed by the first two phases of the Technical Commissioning Plan (TCP) in which the electron beam current is gradually increased while monitoring equipment safety. The TCP is conducted in parallel with Radiation Survey Commissioning, which monitors radiation safety as the ring current is increased. When the beamline equipment has been demonstrated to be capable of safely operating during standard x-ray operations, there is a final radiation survey. The TCP then moves onto a new phase, in which all the key optical components such as the mirrors and monochromator are commissioned in detail in order to determine optimal operating parameters. In a final phase of the TCP, the endstations are commissioned. Scientific commissioning will then follow, with the

participation of expert users, to verify that the beamline meets the design performance goals and to build up endstation and beamline parameters and configurations that optimize beamline performance for routine user operations.

3.1 Radiation Survey Commissioning

A comprehensive *ISR Beamline (4-ID) Radiation Survey Plan* (PS-C-XFD-PRC-065) was developed in accordance with *NSLS-II Beamlines Radiation Safety Commissioning Plan* (PS-C-XFD-PRC-004), which guides the steps needed to control radiological hazards. It includes specific hold points to manage identified radiation risks and maintain commissioning within an approved envelope. The Radiation Survey Plan requires participation and coordination between Beamline, Operations, Radiological Control, and ESH Staff. It identifies specific radiation scatter points along the beamline and provides instruction for mechanical manipulation of the optics to allow for a comprehensive radiological survey along the beamline. Execution of the Radiation Survey Plan, along with the evaluation of the data collected, will be used as a basis by the PSD Director and ESH Manager to approve commissioning activities at an electron beam current of up to 3 times the electron beam current measured during the survey. Approval of commissioning of the beamline at a higher electron beam current requires re-execution of the Radiation Survey Plan. The maximum current allowed during commissioning is indicated on the Caution Tag that is applied by Operations Staff to the beamline enable key. Enabling the beamline at a higher current requires re-execution of the full Radiation Survey Plan and re-approval by the PSD Director and ESH Manager.

3.2 Technical Commissioning

The Technical Commissiong Plan (TCP) documents in some detail the sequence of activities planned to safely commission the beamline. The TCP starts with lowest ring current, and gradually increases ring current until it is at the value for standard operations. At the completion of TCP, all major beamline components will be ready to use, and parameters that optimize their performance will be documented.

3.3 Scientific Commissioning

The ISR beamline will have three endstations: a high-field magnet diffractometer, a six circle diffractometer, and a base diffractometer that accommodates UHV growth chambers. A scientific commissioning plan for each of these endstations will be developed while the technical commissioning takes place. The goal of the scientific commissioning will be to define the beamline parameters and configurations needed for the anticipated scientific program, and the process to bring the complete beamline into routine operations for users.

4. COMMISSIONING ACTIVITY APPROVAL

Work planning needed for safe and efficient commissioning, requires a commissioning SAF and is performed in accordance with *Experiment Safety Review* (PS-C-ESH-PRC-039). This process drives

definition of scope, identification of hazards and controls, and review and approval requirements for all commissioning activities. A commissioning SAF describing the commissioning tasks to be undertaken by the commissioning team will be submitted. This form will include the equipment and materials that will be used, the personnel authorized to participate in the commissioning and any controls that will be placed on the beamline (such as a current or ID gap limit). This form will be submitted to the ESH Manager and PSD Director for approval. This commissioning activity approval process authorizes the commissioning team for a specific task or tasks (such as performing a radiation survey) thereby enforcing a step-by-step and HOLD point approach to commissioning. Most commissioning tasks are expected to take approximately one week to complete, though some may be longer. All commissioning activities will be reviewed on a weekly basis to determine if a new commissioning SAF is needed. This allows for flexibility in the commissioning process, but at the same time ensures that during commissioning the work is periodically reviewed and that the necessary controls are placed on the commissioning activities.

An approved commissioning SAF is required for the beamline to be enabled. Beamline enable is managed in accordance with *Enabling Beamlines for Operations* (PS-C-XFD-PRC-003). This procedure defines the process for enabling the beamline safety shutter and for giving control of that shutter to the Beamline Staff. he process requires participation and coordination between Beamline, Operations, and ESH Staff. A checklist is employed to assure systems are ready (PPS and safety system configuration control) and that staff is prepared to begin.

5. END STATION EQUIPMENT ADDITIONS

Experimental modules will be added to the end station as commissioning moves from technical to scientific, and the focus is shifted to optimizing the photon beam and preparing end station instrumentation for the expected scientific program. All equipment will be added in accordance with the *NSLS-II Process Description: Review Process for Facility Additions and Modifications* (PS-C-CMD-PLN-001), which provides a process for determining the type and extent of reviews warranted.

The end station equipment additions for the beamline have been evaluated and it has been determined that the addition of this equipment will not constitute a sufficient modification of the beamline instrument, and therefore will not require an IRR. These additions will be reviewed through the BNL ESR process, in accordance with *Experiment Safety Review* (PS-C-ESH-PRC-039). This system allows for the treatment of the end stations as experiment areas and provides an electronic mechanism to gather the information needed to define and review equipment and materials in that area. The BNL ESR system contains fields for entry of the equipment and materials to be used, task analyses, control requirement definition, and for ESH review and approval. This approach will be documented in a Tailored Review Plan in accordance with the *NSLS-II Process Description: Review Process for Facility Additions and Modifications* (PS-C-CMD-PLN-001).

The ESRs will be posted at the end station so that they are readily available and provide an ESH envelope of the allowed equipment and activities in the area. This system is used in experiment spaces throughout BNL. Annual review and approval is required, but any change also triggers a system update with an approval requirement. This system will assure careful management of equipment additions and will be correlated with the ESR process planned for the management of User activities.

6. END OF COMMISSIONING; TRANSITION TO OPERATIONS

Commissioning ends when the beamline has shown, through the execution of procedures and surveys, that it meets the NSLS-II shielding policy, that radiation leakage or scatter is controlled to as low as reasonably achievable, that the photon beam is ready for data collection, and that the necessary authorizations for beginning operations have been obtained. Prior to the beamlines commencing User Operations, the process outlined in PS-C-XFD-PRC-030, *Beamline User Readiness* will be completed.

The safety of ongoing beamline operations will be managed with the *Experiment Safety Review* (PS-C-ESH-PRC-039) process, which will control materials, equipment, and tasks at the end station areas through the use of the BNL electronic ESR system. A Cognizant Space Manager is assigned to the area and has responsibility to assure that the system is current and accurate. This system provides a valuable envelope for the resources and allows operations at each location.

Individual experiments will be managed with the electronic SAF section of PASS; a system for Proposal, Allocation, Safety, and Scheduling for User science. The SAF will allow collection of information specific to each experiment and will be reviewed by NSLS-II Staff to determine what hazards are outside the safety envelope established. The SAF will provide the mechanism for definition of scope, analysis of hazards, establishment of controls, and collection of feedback for each experiment. Users must identify the materials and equipment they wish to bring along with a task analysis describing how those items will be used. An iterative review between the User, Beamline, and ESH Staff results in a final approval with definition of requirements.

The SAF process combined with the BNL ESR safety envelope provides the basis needed to assure ongoing control of beamline operation and changes. No additional readiness reviews are expected for 4-ID at this time.