

NSLS-II NEXT BEAMLINE 21-ID COMMISSIONING PLAN



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REV. 1

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REVISION HISTORY

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Acronyms

BNL Brookhaven National Laboratory

ESH Environment, Safety and Health

ESM Electron SpectroMicroscopy

ESR Experiment Safety Review

FE Front End

FLUKA Fluktuierende Kaskade (Monte Carlo simulation software)

ID Insertion Device

IRR Instrument Readiness Review

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 Pla

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1. INTRODUCTION

This plan outlines the actions needed to commission the NSLS-II NEXT 21-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 and focus on delivery of photon beam to the experimental station. 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.

2. SHIELDING

Ray tracing and computer modeling (FLUKA) indicate that 21-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 resulted in a Primary Bremsstrahlung collimator and a Primary Bremsstrahlung stop within the 21-ID-A hutch. Secondary Gas Bremsstrahlung shields were designed following NSLS-II guidelines. The scattering of Bremsstrahlung has been verified using FLUKA, which showed that the secondary shields are adequate at 500mA beam current. The summary of these simulations are provided in *21-ID ESM Beamline Radiation Shielding Analysis* (Tech Note # 217).

3. BEAMLINE COMMISSIONING

The commissioning of the ESM beamlines begins with rough alignment of the optical components at low electron beam current (2mA). Once the beam is successfully directed into the experimental station, the electron beam current will be gradually increased to 85mA, while the radiation level is being monitored. A comprehensive radiation survey is performed at 85mA electron beam current, following the Radiation Survey Plan (see below), to verify that the installed shielding is adequate before moving on to higher beam current. This process is repeated until full current is reached. After first beam, technical commissioning will be carried out to verify the functionality of the beamline components. 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 configuration libraries required for routine beamline operations.

3.1 Radiation Survey Commissioning

A comprehensive ESM Beamline (21-ID) Radiation Survey Plan (PS-C-XFD-PRC-063) 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, radiation 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 NSLS-II 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 NSLS-II PSD Director and ESH Manager.

3.2 Technical Commissioning

The methodology that will be used during the technical commissioning is described in the technical commissioning plan. This plan describes the phased commissioning approach of the beamline and will serve as the basis for the various technical commissioning activities.

3.3 Scientific Commissioning

The ESM beamline will have multiple interchangeable experimental modules, each of which is designed to support a specific type of user experiment. These components and automated sample handling are still under development and expected to become operational during scientific commissioning. A scientific commissioning plan will be developed while the technical commissioning takes place, to define the configuration libraries needed for the anticipated scientific program, test measurements needed to demonstrate beamline performance, and the process to bring the experimental modules and automation into routine operations.

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 Manager 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. The 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 and automation equipment 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.