

NSLS-II Experimental Facilities Beamlines Key Performance Parameters and Commissioning Plan for CD-4

(2nd draft)
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NSLS-II Experimental Facilities overall scope in the NSLS-II construction project includes the completion of design and construction of six project beamlines so that they will be ready for photon beam by the project early completion date June 2014. This document summarizes the experimental facilities key performance parameters (KPPs) for meeting the project milestone CD-4, and an integrated commissioning plan for CD-4 and into early part of NSLS-II operations.

1. Key Performance Parameters and Milestones

When NSLS-II Project is completed, the Experimental Facilities will have met the following key performance parameters and milestones:

Key Performance Parameters:

- Beamline subsystems installed and tested (without beam), including enclosures, beam transport, personnel protection system (PPS), and associated equipment protection system (EPS), utilities, & controls systems
- Main beamline optical systems installed and associated mechanics tested
- Diagnostic instrument installed at endstation to enable beamline commissioning

Milestones:

- Beamline safety configuration review & walkthrough completed
- Beamline readiness report submitted by beamline group

2. Beamline Commissioning Plan

NSLS-II beamlines commissioning will proceed in three phases: commissioning for CD-4 readiness, technical readiness commissioning, and science readiness commissioning.

CD-4 Readiness Commissioning:

Commissioning for CD-4 readiness will be dedicated to systematic testing, without beam, of all mechanical and control functions of installed beamline subsystems required to meet the beamline KPPs defined above. The beamline subsystems include:

- radiation enclosures,
- beam transport,
- utilities,
- personnel protection system,
- equipment protection system,

- control system, and
- main beamline optics.

In addition, an important part of this phase of beamline commissioning is a configuration safety walkthrough for each beamline to verify all safety components are in place and ready to receive beam.

Technical Readiness Commissioning:

Technical readiness commissioning is planned immediately following CD-4. The primary goal of this phase of commissioning is to ensure that all beamline subsystems are functioning properly with beam, as designed, and to characterize the beam in the experimental hutch. A list of typical commissioning tasks and estimated schedule is shown below.

Commissioning of Beamline Components	Days	Required % with X-rays
Bringing first beam into FOE	2	100%
Shielding verification FOE	12	20%
Tuning up front-end components & first mirror	7	80%
Tuning up high-heat-load monochromator	7	100%
Shielding verification EH1/EH2	19	20%
Monochromator energy calibration & range	3	100%
Measurements of energy resolution	2	100%
Photon flux measurements	3	100%
Measurement of undulator spectrum	3	100%
Tuning up beam conditioning optics	6	100%
Study of beam position stability	3	80%
Study of beam energy stability	3	80%
Calibrating adjustable aperture/slits	1	100%
Optics focusing characterization	7	100%
Feedback controls system/software debugging	3	50%
Installation and testing of endstation in experimental hutch	27	0%
Total Scheduled Beam Days Required	81	
Assumed Accelerator Reliability	80%	
Total Calendar Days Required	101	

It should be noted that the above schedule is developed based on standard beamline commissioning procedures at existing facilities and assumed accelerator availability, and additional beamline-specific components may require additional commissioning. In addition, it is expected that an endstation instrument may be assembled, installed, and tested without beam during this commissioning phase.

The time needed for technical readiness commissioning is estimated to be ~ 3 ½ months for a typical NSLS-II project beamline.

Science Readiness Commissioning:

Science readiness commissioning will commence following the successful technical commissioning of the beamline. The primary goal of this phase of commissioning is to commission the endstation instrument and to perform test experiments in order to demonstrate the designed baseline initial science capabilities. A list of typical commissioning tasks and estimated schedule is shown below.

Science Commissioning Tasks	Days	Required % with X-rays
Bringing photon beam into endstation (ES)	3	100%
Beam characterization for designed ES settings	7	100%
Integrated tuning of complete optic system	7	100%
Testing & debugging ES control procedures with beam	4	100%
Measurements of test samples	9	100%
Optimization of overall system & procedures	7	100%
1st experiment on scientific specimen	6	100%
Debugging problems found in 1st experiment	2	50%
Follow-up experiment on 1st scientific specimen	6	100%
2nd experiment on scientific specimen	6	100%
Debugging problems found in 2nd experiment	2	50%
Follow-up experiment on 2nd scientific specimen	6	100%
3rd experiment on scientific specimen	6	100%
Debugging problems found in 3rd experiment	2	50%
Follow-up experiment on 3rd scientific specimen	6	100%
Total Scheduled Beam Days Required	79	
Assumed Accelerator Reliability	80%	
Total Calendar Days Required	99	

The time needed for initial science readiness commissioning is estimated to be ~ 3 ½ months for a typical NSLS-II project beamline, after about a month down period for endstation installation and testing.

3. Summary

The following table summarizes all three commissioning phases, including both technical commissioning goals and administrative procedures and approval milestones.

	Construction Completion (CD-4 Readiness)	Technical Readiness Commissioning	Science Readiness Commissioning	User Operations
Timeline	Before CD-4	0-4 months	4-8 months	
Usable Beam Availability	0%	80%	80%	80%
General User Beam Time Percentage		Staff only	Staff/Commissioning Users	80% General Users
Beamline Readiness Goals	<ul style="list-style-type: none"> • BL subsystems installed & tested, incl. enclosures, beam transport, PPS & EPS, utilities, and controls systems • Main optical systems installed at BL and diagnostic system installed at endstation to enable BL commissioning 	<ul style="list-style-type: none"> • BL shielding verification completed • BL main optics commissioned • Beam properties optimized and characterized (energy, flux, $\Delta E/E$, tunability, stability) • Endstation installed and commissioned • Basic operations procedures established 	<ul style="list-style-type: none"> • Endstation fully characterized for phased initial science capabilities • BL and endstation debugged for initial science experiments • Data acquisition software debugged and functional • Example science experiments performed and preliminary results analyzed 	
Safety and Administrative Approval Procedures	<ul style="list-style-type: none"> • BL safety configuration review & walkthrough • BL readiness technical review (internal) • BL readiness report submitted 	<ul style="list-style-type: none"> • BL shielding certified for operations by ESH • BL commissioning report approved 	<ul style="list-style-type: none"> • Approval for BL user operations 	