Booster Commissioning
Accelerator Readiness Plan
for the
National Synchrotron Light Source II
Photon Sciences Directorate

Version 1
December 8, 2011

Prepared by

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Booster Commissioning
Accelerator Readiness Plan
for the
National Synchrotron Light Source II (NSLS-II)
Photon Sciences Directorate

Submitted: _____ 1/18/2012 TS

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VERSION CONTROL SHEET

Version	Description of any Changes	Date	Preparer	Approved by
1	Original document	December 8, 2011	Timur Shaftan	See page iii

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The *NSLS-II Booster Commissioning Accelerator Readiness Plan* describes the necessary activities to be completed by the responsible Photon Sciences Directorate personnel before commencing the commissioning operations of the Booster. The plan is intended to ensure that the Directorate avoids unsafe or environmentally unsound commissioning operations. It also is intended to help the Department prepare for an appropriate Accelerator Readiness Review (ARR), as required in DOE Order 420.2C, Section 4.b.5. An ARR must be conducted following the declaration by the facility management of accelerator readiness for commissioning operations. The DOE Brookhaven Site Office (BHSO) uses the ARR Report to support its decision to approve the commencement of commissioning operations of the Booster.

I INTRODUCTION

This Booster Commissioning Accelerator Readiness Plan describes the necessary activities to be completed by the Photon Sciences Directorate (PSD) before commencing NSLS-II Booster Commissioning. The plan is intended to ensure that the Photon Sciences Directorate avoids unsafe or environmentally unsound commissioning. It also is intended to help the Photon Sciences Directorate prepare for an appropriate Accelerator Readiness Review (ARR), as required in DOE Order O 420.2C. An ARR must be conducted following the declaration by Photon Sciences Directorate management that the NSLS-II Booster is ready for commissioning activities.

The Booster Ring contains four quadrants and four straight sections located inside the Booster tunnel with the beam height centered at 1.200 m. Each quadrant contains the following magnetic elements:

- 8 combined function defocusing dipole magnets (BD) with 8.39° bending angle
- 7 combined function focusing dipole magnets (BF) with 3.27° bending angle
- 6 quadrupole magnets to adjust the tune point
- 4 sextupole magnets arranged in two families for correction of chromaticity and optimization of the dynamic aperture

The global orbit correction system of the Booster system consists of 36 beam position monitors (BPM) as well as 20 horizontal and 16 vertical corrector magnets. There are 6 beam screens, 1 DCCT, and one Synchrotron Radiation Monitor for machine commissioning and beam tuning.

Four 8 m long straight sections include the injection and extraction straights, an RF straight section and a diagnostics straight section. These sections consist of:

- Injection straight section (low energy transport line coming from the Linac): one injection septum and 4 injection kickers with associated vacuum chambers and diagnostics
- Extraction straight section (high energy transport line going to the Storage Ring): pulsed and DC extraction septa, 1 extraction kicker, 4 slow bumps, and associated vacuum chambers and diagnostics
- RF section: 500 MHz RF cavity with vacuum chambers and a BPM
- Diagnostics straight section: two striplines, 2 BPMs and their vacuum chambers.

The following equipment is located downstream of the Booster:

- A diagnostics transport line terminating in the beam stop with a Faraday cup
- A further part of the Booster-to-Storage Ring Transport Line. This part includes a Safety Shutter and penetrates through the Booster shield wall delivering the Booster electrons to the Storage Ring

The following equipment is located in the Injection Service Area adjacent to the Booster tunnel:

- One IOT transmitter (80 kW), modulator, power supply and waveguide structure.
- Booster power supplies including two 400 V, 900 A BD power supplies and one 200 V, 900 A BF power supply, quadrupole, sextupole and corrector power supplies, <25 kV charging power supplies for the pulsed magnets
- Vacuum pump power supplies and electronics
- Diagnostics and instrumentation electronics
- Controls electronics

When commissioned, the NSLS-II Booster is subject to the requirements of the DOE Accelerator Safety Order, DOE 420.2C or its successors. The NSLS-II Booster is classified as an accelerator facility with potential for no more than minor on-site and negligible off-site impacts to people and the environment. The possibility of any off-site impacts or major on-site impacts is highly unlikely due to the physical and operational aspects of the NSLS-II Booster. The radiation hazard from electron beams, which is a non-standard industrial hazard, is confined to the beam pipe or immediate surroundings, and is in existence only when a beam is present. Other hazards at the NSLS-II Booster are standard industrial hazards that were also determined to be low risk. These hazards are documented in the NSLS-II Booster Commissioning Safety Assessment Document.

During commissioning, routine radiation surveys by qualified Radiological Control Technicians using portable radiation monitors will be used to verify the radiation-protection controls on a regular basis. Fixed area monitors will be installed around the Booster enclosure (Credited Controls) and inside the Storage Ring enclosure where the Booster transport line enters. Personnel and area dosimeters will also be used.

The following subsystems that make up the NSLS-II Booster will be available for a readiness review by the ARR Team:

- RF System
- Power Supply Systems and the High-Voltage Platform
- Magnet Systems
- Vacuum Systems
- Water Cooling and Compressed Air Systems
- Controls Systems
- Beam Diagnostics
- Radiaton shields including beam dumps
- Engineered Safety Systems
- Confined Space designations

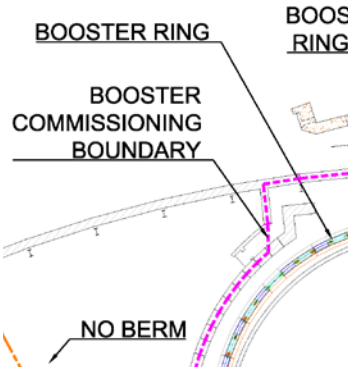

Figure 1: Booster Ring. The dashed line shows the area involved in Booster commissioning.

The NSLS-II Booster is being procured from the Budker Institute of Nuclear Physics (BINP). BINP is responsible for commissioning the Booster under the supervision of PSD, and showing that it meets specification, as per the contract. However, some of the suite of diagnostics to commission the Booster is contained in the transport lines, which is the responsibility of PSD. Therefore, commissioning the Booster and the transport lines will be a coordinated effort between BINP and PSD with each side responsible for their portion, following a single plan called the Booster Commissioning Sequence.

Aspects of the NSLS-II Booster ready for verification by the ARR Team:

- Booster Commissioning Safety Assessment Document
- Booster Commissioning Accelerator Safety Envelope
- Conduct of Operations (CONOPs) manual
  - Procedures necessary for safe operation
  - Procedures to deal with abnormal and emergency situations
  - Control Room staffing requirements
- Records and procedures document control process to assure that changes are reviewed, approved, and retained

- Systems readiness review
- Training and qualification programs
- Unreviewed Safety Issue process

The NSLS-II Booster is located on the inside perimeter of Building 740 inside the Injection Building, as shown in Figure 1 above. The planned date (subject to change) for commissioning to start is on or about mid-January 2013. Thus, it is anticipated that the ARR Team may begin their verification of readiness to start tasks on or about early-January 2013 (subject to change).

II RELEVANT DOCUMENTS

Documents available to the ARR Team:

- Booster Commissioning Safety Assessment Document
- Booster Commissioning Accelerator Safety Envelope
- NSLS – II Booster Commissioning Conduct of Operations
- NSLS – II Booster Commissioning Operations Procedures
- NEPA Documentation
- NESHAPS Documentation
- Fire Hazard Analysis
- Drawings
- System Readiness Reviews
- Photon Sciences Division Unreviewed Safety Issues procedure

III CONDUCT OF OPERATIONS

The organization and administration of the Booster commissioning is intended to achieve a high level of safety and performance that is accomplished through effective implementation and control of commissioning activities. Operational procedures will be established to protect the environment, and assure safe and efficient operations. A formal Conduct of Operations Manual is under development and will be in place prior to the start of commissioning. A few key elements of the Conduct of Operations program that will be established for Booster commissioning include:

Notifications:

- Problems encountered during commissioning (e.g., operational, safety, scheduling problems) are initially reported to the Accelerator Operator on Duty. Additional required notifications will be defined in the operational or ESH procedures.
- Necessary notifications for commissioning or obtaining authorizations are the responsibility of Timur Shaftan or designee.

Anticipated NSLS-II Booster commissioning activities requiring authorization:

- Starting-up or restarting designated systems
- Performing corrective maintenance on systems
- Producing or removing existing procedures
- Approving temporary procedures
- Signing-off changes to procedures

Other commissioning activites not explicitly requiring authorization, such as the delegation of authority, shall be included in the Conduct of Operations.

All commissioning activities will be planned according to the PSD *Work Planning and Control* procedure as described in LS-ESH-PRM-1.3.6. This document describes how all work in the Photon Sciences Directorate complies with BNL SBMS subject area *Work Planning and Control for Experiments and Operations.*

IV TRAINING

The following persons will require a formal qualification prior to participating in the NSLS-II Booster commissioning:

- Designated persons from BINP
- Members of the Photon Sciences Directorate Injection Systems Group
- Members of the Photon Sciences Directorate RF Group
- Photon Sciences Directorate subsystem experts
- Members of the Photon Sciences Directorate Operations Group
- BNL Radiological Control Division personnel assigned to support the Booster commissioning
- Photon Sciences ESH Group

The requirements for the qualification program will be established by the responsible Group Manager in conjuction with the ESH Group Leader. The PSD Training Coordinator (Mary Anne Corwin) will be responsible for record keeping and tracking compliance with training and qualification requirements established for each position.

V CONTINGENCY PROCEDURES

An important aspect of the commissioning process is the confirmation of the adequacy of the shielding provided to protect personnel from elevated radiation levels. Any shielding weaknesses or deficiencies identified by radiological surveys conducted during commissioning will be quickly remedied. There will be a pallet of painted lead bricks available in the Injection Service Area in case additional supplementary shielding is needed to reduce radiation levels to as low as reasonably achievable (ALARA).

VI COMMISSIONING AND OPERATIONS MODULES

Module for Commissioning and Pre-Operations of the NSLS-II Booster, Persons Responsible, Scheduled Readiness Date

SCHEDULE: Booster commissioning with beam on or about January 2013.
DESCRIPTION: The Booster will accelerate electrons and transport to the Booster beam dump.
OPERATING ITEMS (persons responsible subject to change) 1. All related Instrument/Experiment Readiness Review items are closed out (T. Shaftan) 2. All related Accelerator Readiness Review items are closed out (A. Ackerman) 3. The Personel Protection System is operational (S.Buda) 4. The Area Monitoring System is operational (W.R. Casey) 5. Emergency procedures are complete (R. Chmiel) 6. Operations procedures are complete (M. Buckley) 7. Commissioning sequence is complete (T. Shaftan) 8. Fault Study Plan prepared (T. Shaftan) 9. Supplemental Shielding is installed and configuration control is established (A. Ackerman) 10. LESH Review Committee issues closed out (N. Gmür) 11. Sweep procedures are complete (A. Ackerman) 12. Training records of commissioning staff are complete (M. Corwin)

List of Contacts for Additional Information Regarding Controls or Subsystems Not Specifically Identified or Credited in the BCASE

A number of systems have inherent industrial hazards that must be addressed as required by the BNL SBMS subject areas (persons responsible subject to change). These systems require a specific review and authorization prior to initial turn-on and start-up of equipment. These reviews are designated as the Instrument Readiness Review. Authorization to begin system startup will require satisfaction of designated recommendations made during the Review.

Mechanical Utilities for Booster Commissioning

- Compliance with ASME Piping Codes (S. Sharma or designee)

Electrical Utilities for Booster Commissioning

- Installation in accordance with National Electric Code 2005 (G. Ganetis or designee)
- NRTL or equivalent rated equipment (G. Ganetis or designee)

Booster to Storage Ring Transfer Line Subsystems

- Compliance with ASME Piping Codes (S. Sharma or designee)
- Electrical subsystems in accordance with applicable SBMS subject areas and OSHA 1910.305 where applicable (G. Ganetis or designee)
- Magnet Design reviewed for electrical safety (G. Ganetis)

- NRTL or equivalent rated equipment (G. Ganetis or designee)

Booster Subsystems

- Compliance with ASME Piping Codes (B. Kieffner or designee)
- Electrical subsystem in accordance accordance with applicable SBMS areas and OSHA 1910.305 where applicable (G. Ganetis or designee)
- RF shielding in compliance with IEEE C95.1-1999 as applicable (Jim Rose or designee)
- NRTL or equivalent rated equipment (G. Ganetis or designee)
- DC Current Transformer Interlock (O. Singh or designee)

VII ENGINEERED AND ADMINISTRATIVE CREDITED CONTROLS

For commissioning with electron beam, the following engineering control programs must be implemented and each must be documented, meet applicable BNL SBMS requirements, and be approved by line management to be acceptable.

a. A personnel protection interlock system (PPS) for radiation hazard control must be operational.

b. Radiological shielding and fencing must be in place.

For commissioning with electron beam, the following administrative control program must be documented, meet applicable BNL SBMS requirements, and be approved by line management to be acceptable.

a. Personnel protection interlocks must be tested and maintained in accordance with the requirements specified in the BNL Standards Based Management System and Radiological Control Manual.

b. The active, interlocked radiation monitors must be calibrated and maintained in accordance with the requirements specified in the BNL Standards Based Management System and Radiological Control Manual.

c. A radiation protection configuration control program must be in place to protect the functions provided by the PPS and the radiation shields.

d. A radiation monitoring and control program must be in place to verify adequacy of shielding and operational control of radiation exposure.

e. The power supply to the BS-B2 magnet and the position of the BS-SS safety shutter shall be locked and tagged in the safe position during Booster commissioning.

f. At least one qualified, trained Accelerator Operator shall be on-duty during Booster commissioning with electron beam.

VIII LIST OF COMMISSIONING PROCEDURES REQUIRED FOR COMMISSIONING READINESS

Persons responsible subject to change.

- LockOut TagOut Procedures (A. Ackerman)
- Local Emergency Procedure (B. Chmiel)
- Emergency Call Down Lists (T. Shaftan)
- Interlock Procedures (S. Buda)
- Radiation Monitor Calibration Procedure (R. Casey)
- Shielding Configuration Control Program (A. Ackerman)
- Response to elevated radiation levels and alarms (S. Hoey or designee)
- Operator response to DCCT interlock (T. Shaftan or designee)
- Booster Commissioning Sequence including Radiological Survey Points (T. Shaftan, R. Casey, F. Zafonte)