

Linac Commissioning Plan
for the
National Synchrotron Light Source II
Photon Sciences Directorate
Version 1



May 10, 2011

Prepared by
Brookhaven National Laboratory
P.O. Box 5000
Upton, NY 11973-5000
managed by
Brookhaven Science Associates
for the
U.S. Department of Energy
Office of Science
Basic Energy Science
under contract DE-AC02-98CD10886

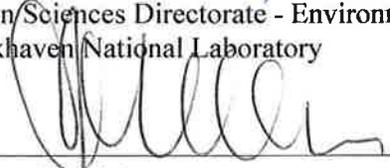
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe on privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency, contractor, or subcontractor thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency, contractor, or subcontractor thereof.

Photon Sciences Directorate
National Synchrotron Light Source II (NSLS-II)
LINAC COMMISSIONING PLAN

Submitted:  _____ 5/26/11
Ray Filler _____
Photon Sciences Directorate - Preparer
Brookhaven National Laboratory Date

Approval:  _____ 5/26/11
Steven Hoey _____
Photon Sciences Directorate - Environment, Safety & Health Manager
Brookhaven National Laboratory Date

Approval:  _____ 2011/05/26
Ferdinand Willeke _____
Photon Sciences Directorate – Accelerator Division Director
Brookhaven National Laboratory Date

VERSION CONTROL SHEET

VERSION	DESCRIPTION OF ANY CHANGES	DATE	PREPARER	Approved by
1	Original document	May 10, 2011	Ray Filler	See page iii

Table of Contents

Contents

I INTRODUCTION.....	7
II RELEVANT DOCUMENTS	9
III CONDUCT OF OPERATIONS.....	9
IV TRAINING	10
V CONTINGENCY PROCEDURES.....	11
VI COMMISSIONING AND OPERATIONS MODULES	11
VII ENGINEERED AND ADMINISTRATIVE CREDITED CONTROLS	12
VIII LIST OF COMMISSIONING PROCEDURES REQUIRED FOR COMMISSIONING READINESS (PERSON RESPONSIBLE).....	13
IX RESPONSIBILITY MATRIX	15

The NSLS-II Linac Commissioning Plan describes the necessary activities to be completed by the responsible Photon Sciences Directorate personnel before commencing the commissioning operations of the Linac. 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 420.2b, Section 5 b. (2) (b). 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 Linac.

I Introduction

This commissioning plan describes the necessary activities to be completed by the Photon Sciences Directorate (PSD) before commencing NSLS-II Linac 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 420.2B. An ARR must be conducted following the declaration by Photon Sciences Directorate management that the NSLS-II Linac is ready for commissioning activities.

For the purposes of this Commissioning Plan, the NSLS-II Linac is comprised of a DC electron gun, low energy buncher section, four accelerating cavities, the associated transport lines up to and including the two beam dumps, and the safety shutter, three klystrons, associated water cooling systems, associated power supplies, and electronics for controls and dagnotics shown below:

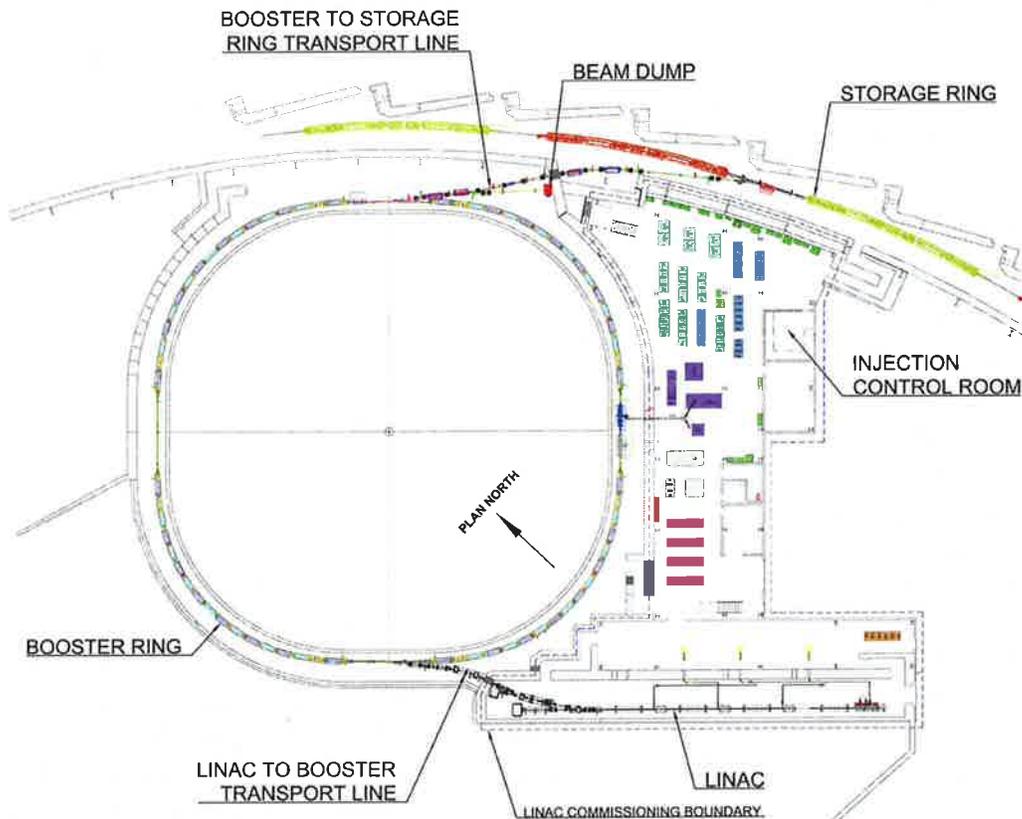


Figure 1: Linac and Linac to Booster Transport line. The linac commissioning boundary shows the area involved in linac commissioning.

When commissioned as a pre-injector to NSLS-II, the NSLS-II Linac is subject to the requirements of the DOE Accelerator Safety Order, DOE 420.2B or its successors. The NSLS-II Linac 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 aspects of the NSLS-II Linac. 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 Linac are standard industrial hazards that were also determined to be low risk. These hazards are documented in the NSLS-II Linac 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 in the klystron gallery and in the booster enclosure. Personnel and area dosimeters will also be used.

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

- Electron Gun
- RF Cavities
- RF Power Systems
- Power Supply Systems and the High-Voltage Platform
- Magnet Systems
- Vacuum Systems
- Cooling Systems
- Controls Systems
- Beam Diagnostics
- Radiation shields including beam dumps
- Engineered Safety Systems

The NSLS-II linac is being procured from Research Instruments GmbH (RI). RI is responsible for commissioning the linac under the supervision of BNL, and showing that it meets specification, as per the contract. However, some of the suite of diagnostics to commission the linac is contained in the transport line, which is the responsibility of BNL. Therefore commissioning the linac and the transport line will be a coordinated effort between RI and BNL with each side responsible for their portion, following a single plan called the Linac Commissioning Sequence.

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

- Linac Commissioning Safety Assessment Document
- Linac 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
- Unreview Safety Issue process

The NSLS-II Linac is located on inside perimeter of Building 740 inside the Injection Building as shown in Figure 1. The planned date for commissioning to start is November 7, 2011. Thus, it is anticipated that the ARR Team may begin their verification of readiness to start tasks on or about October 17, 2011.

II Relevant Documents

Hyperlinks to documents available to the ARR Team:

- [Linac Commissioning Safety Assessment Document](#)
- [Linac Commissioning Accelerator Safety Envelope](#)
- NSLS – II Linac Commissioning Conduct of Operations
- NSLS – II Linac 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 Linac 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 Ops program that will be established for Linac commissioning include:

. Notifications:

- Problems encountered during commissioning (e.g., operational, safety, scheduling problems) are initially reported to the Linac 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 Raymond Fliller or designee.

Anticipated NSLS-II Linac 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 activities 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 *Work Planning and Control for Experiments and Operations Subject Area*.

IV Training

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

- Designated persons from RI Research Instruments GmbH
- 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

- Radiological Control Division Personnel assigned to support the Linac commissioning
- Photon Sciences ESH Group.

The requirements for the qualification program will be established by the responsible Group Manager in conjunction with the ESH Group Leader. The PS 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. Efforts will be made to quickly reduce any weaknesses or deficiencies identified by radiological surveys conducted during commissioning. There will be a pallet of 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 Linac, Persons Responsible, Scheduled Readiness Date

SCHEDULE: Linac operations with beam on or about November 7, 2011.
DESCRIPTION: The linac will accelerate electrons and transport to both beam dumps.
OPERATING ITEMS (Persons Responsible)
<ol style="list-style-type: none"> 1. All related I/ERR items are closed out (R. Fliller) 2. All related ARR items are closed out (A. Ackerman) 3. The Personnel Protection System is operational (S.Buda) 4. The Area Monitoring System is operational (B. Casey) 5. Emergency procedures are complete (B. Chmiel). 6. Operations procedures are complete (M. Buckley) 7. A commissioning sequence is complete (R. Fliller) 8. Fault Study Plan prepared (R. Fliller) 9. Supplemental Shielding is installed and configuration control is established (A. Ackerman) 10. LESH Review Committee issues closed out (N. Gmur) 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 ASE

There are a number of systems that have inherent industrial hazards that must be addressed as required by the Lab SBMS standards. These systems require a specific review and authorization prior to initial turn-on and start-up of equipment. These reviews are designated as the System Readiness Review. Authorization to begin system startup will require satisfaction of designated recommendations made during the Review.

Mechanical Utilities for Linac Commissioning

- Compliance with ASME Piping Codes (B. Kieffner)

Electrical Utilities for Linac Commissioning

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

Linac to Booster Transfer Line Subsystems

- Compliance with ASME Piping Codes (B. Kieffner)
- Electrical subsystems in accordance with applicable SBMS areas and OSHA 1910.305 where applicable (G. Ganetis or designee)
- Magnet Design reviewed for electrical safety (B. Wahl)
- NRTL or equivalent rated equipment (G. Ganetis or designee)

Linac Subsystems

- Compliance with ASME Piping Codes (J. Rose or designee)
- Electrical subsystem in accordance with applicable SBMS areas and OSHA 1910.305 where applicable (J. Rose or designee)
- RF shielding in compliance with IEEE C95.1-1999 as applicable (A. Ackerman)
- NRTL or equivalent rated equipment (J. Rose or designee)
- Integrating Current Transformer Interlock (R. Filler)

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 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 certified prior to initial operation, and re-validated at 6 month intervals – not to exceed 8 months.
- b. The active, interlocked radiation monitors must be calibrated at 12 month intervals.
- c. A radiation protection shielding configuration control program must be in place.
- d. A radiation monitoring and control program must be in place to verify adequacy of shielding and operational control of radiation exposure.
- e. The LB-B2 Linac dipole bending magnet power supply and the LB-SS1 Linac-to-Booster Transport Line safety shutter must be locked and tagged out when the adjacent section of the Booster enclosure is occupied and the Linac is using electron beam.
- f. At least one qualified, trained Linac Operator shall be on duty and available at one of the Control Rooms or in the Injection Building service area when commissioning the Linac system and transport line with electron beam.

VIII List of Commissioning Procedures Required for Commissioning Readiness (Person Responsible)

- LockOut TagOut Procedures (A. Ackerman)
- Local Emergency Procedure (B. Chmiel)
- Emergency Call Down Lists (R. Fliller)

- Interlock Procedures (S. Buda)
- Radiation Monitor Calibration Procedure (B. Casey)
- Shielding Configuration Control Program (A. Ackerman)
- Response to elevated radiation levels and alarms (S. Hoey or designee)
- Operator response to ICT interlock (R. Fliller or designee)
- Requirements for operation with 3 klystrons (R. Fliller or designee)
- Requirements for operating at pulse rates > 1 Hz (R. Fliller or designee)
- Linac Commissioning Sequence including Radiological Survey Points (R. Fliller and Bob Casey)

