Brookhaven National Laboratory/ Photon Sciences Directorate

Subject:	NSLS-II USI #3 – Correction of NSLS-II LCSAD Typographical Error			
Number:	LT-ESH-USI-003	**Version:** 1	**Effective:** 14Mar2012	**Pages** 1 - 5
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*Approval signatures on file with master copy

VERSION	DESCRIPTION OF ANY CHANGES	DATE	PREPARER	APPROVED BY
1	Original document	14Mar2012	Nicholas Gmür	See signatures above

EMS, FUA and SAD/ASE Checklist for Photon Sources Directorate Reviews

(Photon Sources Directorate ES&H personnel and the Environmental Compliance Representative can assist in completing this form)

Review Committee: Laboratory ESH Committee **Date: 14Mar2012**

Project Name (and # if any): NSLS-II USI #3

This checklist identifies issues associated with this project that may impact the Directorate Environmental Management System, Occupational Health & Safety Management System, Facility Use Agreements, Safety Assessment Documents & Accelerator Safety Envelopes, and NEPA documents. This checklist will be completed during a review process, if needed, and form part of the documentation of that review.

SIGNIFICANT ENVIRONMENTAL ASPECTS ASSOCIATED WITH THIS PROJECT:

Check off any environmental aspects that are associated with this project (Photon Sciences Directorate Environmental Management System aspects matrices show the significant aspects). For criteria, go to the SBMS Subject Area titled Identification of Environmental Aspects and Impacts

☐	Industrial Waste Generation	☐	Work with Engineered Nanomaterials	☐	Power Consumption	☐	Historical Contamination (groundwater, soil)
☐	Hazardous Waste Generation	☐	Atmospheric Emissions	☐	Engineered Nanomaterials	☐	Soil Activation
☐	Radioactive Waste Generation	☐	Liquid Effluents	☐	Historical Monuments/Cultural Resources	☐	Transuranic Waste Generation
☐	Mixed Waste Generation	☐	Storage or Use of Chemicals or Radioactive Materials*	☐	Sensitive/Endangered Species and Sensitive Habitats (including Pine Barrens)		Other Regulatory Requirements - recycling
☐	Medical Waste Generation	☐	Water Consumption	☐	Environmental Noise	☐	NONE

*Art 12 registered area, spill potential, transportation of hazmat or rad, backflow devices, PCBs.

Any environmental aspects new to the Photon Sciences Directorate: ☐Y or ☒N? Any aspects associated with new activities: ☐Y or ☒N? If yes, describe below and issue a memo to the appropriate Photon Sciences Directorate ESH Manager:

APPLICABLE REGULATORY REQUIREMENTS:

Check off any BNL Subject Areas that are applicable to this process:

Note: PI's should consider subscribing to the Subject Area Subscription Service as a means of staying informed of changes to the Subject Area requirements.

☐	Drinking Water	☐	Radioactive Waste Management
☐	Environmental Monitoring	☐	Regulated Medical Waste Management
☐	Hazardous Waste Management	☐	Spill Response
☐	Liquid Effluents	☐	Storage and Transfer of Hazardous & Non-hazardous Materials
☐	Mixed Waste Management	☐	Transfer of Hazardous or Radioactive Materials On-Site
☐	National Environmental Policy Act (NEPA) and Cultural Resource Evaluation	☐	Transport of Hazardous or Radioactive Materials Off-Site
☐	Non-Radioactive Airborne Emissions	☐	Underground Injection Control
☐	PCB Management	☐	Regulated Industrial Waste Management
☐	Pollution Prevention and Waste Minimization	☐	Working with Nanomaterials ES&H
☐	Radioactive Airborne Emissions	☐	None

Facility Use Agreement (FUA)

Answer "Yes" or "No" for each category below.

Category	Applicable		Elements and Details
	Yes	No	

Radiological Source Terms	☒	☐	*See FUA Table 4.1.1 for details.*
Chemical, Toxic, Biological & Hazardous Source Terms	☐	☒	*See FUA Table 4.1.2 for details.*
Physical Source Terms	☐	☒	*See FUA Table 4.1.3 for details.*

If yes, do any terms require an update to the FUA: ☐Y or ☒N? If yes, describe below and issue a memo to the appropriate Photon Sciences Directorate ESH Manager: **Note: The FUA for building 740 will be written once construction has been completed. Radiological information would be included at that time.**

Safety Assessment Document (SAD)/Accelerator Safety Envelope (ASE)

Does this project include components that exceed or are not included in the safety boundaries described in the SAD or the ASE: ☒Y or ☐N? If yes, describe below and issue a memo to the appropriate Photon Sciences Directorate ESH Manager: **Activities that may increase the level of a known hazard or may introduce a new type of hazard not examined in a Safety Assessment Document, and therefore may impact the items below must be evaluated through the PSD USI determination process:**

- The radiation hazard personnel protection system (PPS)
- Radiation shielding for personnel protection
- Radiation monitoring for personnel protection
- ✓Radiological source terms identified in the SAD
  - Beam loss assumption value typographical error
- Hazards identified in the SAD

Job/Facility Risk Assessments (JRA/FRA)

Does this project include components that exceed or are not included in the jobs, hazards, controls or risks described in the JRA/FRAs: ☐Y or ☒N? If yes, describe below and issue a memo to the appropriate Photon Sciences Directorate ESH Manager:

NEPA Environmental Assessment (EA)

Does this project include components that exceed or are not included in the NEPA EA:

☐Y or ☒N? If yes, describe below and issue a memo to the Photon Sciences Directorate ESH Manager:

NSLS-II Unreviewed Safety Issue #3

Correction of NSLS-II LCSAD Typographical Error

Introduction

This document is prepared as an addendum to the existing National Synchrotron Light Source II (NSLS-II) Linac Commissioning Safety Assessment Document (LCSAD); dated May 11, 2011. It corrects a typographical error found in Table 4.2. This change is analyzed as an Un-reviewed Safety Issue (USI) as defined in DOE Order 420.2C, *Accelerator Safety*.

Executive Summary

The NSLS-II Linac is being constructed as part of the injection system for the new NSLS-II Storage Ring. The LCSAD currently lists the following Table 4.2:

Table 4.2: Beam Loss Assumptions Used for Linac Calculations

Accelerator System	Energy (MeV)	Charge Loss (nC/s)
Linac - General	200	1
First bending magnet	230	2.5
Energy slit	230	11
Beam dumps	230	22

This table is revised to correct a typographical error and thus reads as follows:

Table 4.2: Beam Loss Assumptions Used for Linac Calculations

Accelerator System	Energy (MeV)	Charge Loss (nC/s)
Linac - General	200	1
First bending magnet	230	22
Energy slit	230	11
Beam dumps	230	22

Discussion

This error was found during presentations to the Linac Commissioning Accelerator Readiness Review committee (February 27, 2012). Calculations utilizing the 22 nC/s loss value are properly incorporated elsewhere in the LCSAD (see below).

4.15.2.2.1 Linac

Evaluation of abnormal conditions

Note that all radiation levels are calculated in contact with the exterior surface of the shield wall.

1. Full beam loss (100%) at a point assuming 250 MeV and 22 nC/s operation

   a. At any location in the Linac without supplemental shields, the highest radiation levels (at 90°) will be:

      (22 nC/s ÷ 1 nC/s) x (250 MeV ÷ 200 MeV) x 0.5 mrem/h = 13.8 mrem/h in the Klystron Gallery and on the earth shielding (i.e. berm) above and adjacent to the Linac enclosure

      Radiation produced at 0° will strike either one of the beam dumps and will not result in elevated radiation levels in occupied areas.

   b. Beam dumps are shielded for the full beam at 230 MeV and 22 nC/s. Therefore the maximum radiation level when operating at 250 MeV is (22 nC/s ÷ 22 nC/s) x (250 MeV ÷ 200 MeV) x 0.5 mrem/h = 0.54 mrem/h in any location outside the Linac enclosure in the vicinity of the beam dumps.

   c. The energy slit is shielded with supplemental lead shields at 90° for 230 MeV and 11 nC/s. Therefore the radiation level for full beam loss at 250 MeV and 22 nC/s is ~1.0 mrem/h on the berm above the Linac enclosure and in the Klystron Gallery in the vicinity of the energy slit. A lead collimator is provided along the beam in the wall between the Linac and the Booster enclosure and provides shielding for 11 nC/s at 230 MeV to reduce radiation levels in the Booster enclosure to 0.5 mrem/h. The supplemental shield enclosing the energy slit protects the Booster wall from radiation emitted at wider angles. Loss at 22 nC/s at the energy slit would raise radiation levels in the Booster enclosure to <1 mrem/h.

      Conclusion: The maximum radiation level outside the shielding for electrons at 250 MeV and a full beam loss of 22 nC/s in the Linac is ~14 mrem/h.

4. Bending magnet 1 (LB-B1) or bending magnet 2 (LB-B2) are miss-set and the beam is miss-steered from intended path.

   During commissioning of the Linac there are two modes in which the first dipole (LB-B1) can operate. (see Table 4.4 below) In mode 1, the Linac beam will be transported to the straight ahead to beam stop #1. In this mode LB-B1 must be full off to prevent miss-steering.

In mode 2, the Linac beam will be transported to the second stop. In this mode, LB-B1 must be set to the correct value for the Linac beam energy, and LB-B2 must be full off. Since the Booster can be occupied during Linac commissioning, LB-B2 must be off at all times to prevent beam from being bent into the Linac to Booster transport line. The PPS system will monitor the status of the Booster tunnel and will require that LB-B2 be off and the safety shutter (LB-SS1) be closed (they will also be LoTo'ed off and closed) when the Linac is secure and the Booster is open.

If LB-B1 is not set to the proper current, the electron beam can be miss-steered into the vacuum pipe downstream of the bend. Ray traces of possible electron trajectories have been performed and lead shadow shields have been positioned to insure that the electron/bremsstrahlung beam generated when the electron path intercepts the vacuum chamber wall is terminated before it can strike the concrete wall between the Linac and the Booster. Based on 22 nC/s losses at 230 MeV, a minimum of 15 cm of lead is specified to reduce radiation levels in the Booster enclosure to < 5 mrem/h under this fault condition.

Table 4.4: Linac-to-Booster modes of operation

Modes of Operation	Bending Magnet #1	Bending Magnet #2
Booster unsecured	--	OFF
Electron beam to beam dump #1	OFF	--
Electron beam to beam dump #2	ON	OFF
Electron beam to secured Booster*	ON	ON

*This mode of operation is not authorized during Linac commissioning.

Conclusion:
No additional engineered controls are necessary to satisfy the Shielding Policy. The lead shields are subject to formal configuration control to ensure proper placement and control. During commissioning an area monitor with local alarms and rate meter display with sensitivity to neutrons shall be installed in the Booster enclosure on the common wall between Booster and Linac to provide additional warning of elevated radiation levels generated by miss-steered beam. Interlocking is not required for this area monitor.

Conclusion
A typographical error has been corrected in Table 4.2 of the LCSAD, i.e. the first bending magnet charge loss has been changed from 2.5 to 22 nC/s. No other changes are needed in the remainder of the LCSAD as this typographical error is not found elsewhere.