

Brookhaven National Laboratory/ PHOTON SCIENCES DIRECTORATE			
<b>Subject:</b>	<b>INTERLOCK SAFETY</b>		
<b>Number:</b>	PS-ESH-PRM-1.5.3	<b>Revision:</b>	1
		<b>Effective:</b>	11/28/2011
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\*Approval signatures on file with master copy.

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## 1. PURPOSE

Protection for employees, visiting scientists and outside contractors exposed to high hazard energy potential shall be achieved through comprehensively designed, fully functional interlock systems and operational procedures. Photon Sciences (PS) staff and users are required to follow the requirements identified in this document. A complete description of the Personnel Protection Interlocks within the NSLS is provided in "[Radiation Safety Interlocks at the NSLS](#)." A description of NSLS-II interlocks is available within the Photon Sciences Document System.

## 1. SCOPE

**2.1** Interlocks shall be provided for all equipment or locations where the potential exists for exposure to high levels of radiation or other hazardous energy sources if the equipment were inadvertently operated with personnel in the potentially exposed area. Interlocks shall be installed where these hazards are not adequately protected by other means (i.e. barricade or lockout). When interlocks are required, they shall be designed in accordance with "Interlock Safety for High Risk Hazards" requirements within the BNL Standards-Based Management System (SBMS).

**2.2** High Radiation Areas and Very High Radiation Areas shall have interlock systems that meet the requirements of the "BNL Radiological Control Manual" and "Interlock Safety for High Risk Hazards" requirements within SBMS.

**2.3** Laser systems requiring interlocks shall comply with SBMS "Laser Safety" subject area and BNL "Interlock Safety for High Risk Hazards" requirements within SBMS.

**2.4** RF and microwave energy systems requiring interlocks shall comply with "Non-ionizing Radiation Safety" subject area and "Interlock Safety for High Risk Hazards" requirements within SBMS.

**2.5** Analytical x-ray facilities shall comply with the BNL Radiological Control Manual and BNL "Interlock Safety for High Risk Hazards" requirements within SBMS.

**2.6** Miscellaneous electrical equipment shall comply with Electrical Safety subject area and BNL "Interlock Safety for High Risk Hazards" requirements within SBMS.

## 3. RESPONSIBILITIES

**3.1** The Accelerator Operations Group Leader is responsible to ensure that operations of the Photon Sciences facilities are conducted only when all interlock systems are fully functional and tested within the 6 month requirements. The PS Safety Officer is responsible to ensure that the accelerator beam lines are operated with interlock systems that are fully functional and tested within the 6 month requirements.

**3.2** The PS Safety Officer in conjunction with the Accelerator Operations Group Leader and the NSLS Interlock Working Group (IWG), shall define appropriate interlock requirements for radiation and laser systems.

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**3.3** The Photon Sciences Interlock Engineer shall ensure that the technical documents for PS interlock systems are accurate and current, and shall supervise the installation of all PS radiation and facility laser interlock systems. The PS Interlock Engineer shall inform the PS Safety Officer or PS Safety Engineer of any planned modifications or repairs to the interlock systems along with the interlock components or systems affected by the modifications or repairs. Upon the completion of repairs or modifications the PS Interlock Engineer or designee must discuss/review the work completed with the ESH Testing personnel in order to verify the proper testing requirements.

The Interlock Working Group shall meet prior to each major shutdown or other times of significant interlock modifications to ensure full definition of scope of work, specification of controls, and determination of the recertification process prior to start of the work.

**3.4** Construction, modification, maintenance, repairs, and testing of radiation and facility laser interlock systems may be done only by or under the direction of the PS Accelerator Safety Systems Group, the PS Interlock Engineer or the PS Safety Officer.

**3.5** The PS Safety Officer or Safety Engineer shall schedule and conduct tests for radiation protection and laser interlock systems as defined in Interlock Safety for High Risk Hazards requirements within SBMS, and maintain test records. A post work meeting shall take place between the PS Interlock Engineer or designee and ESH Test personnel indicated above to discuss/review the work completed in order to verify the proper testing requirements.

**3.6** The PS Interlock Working Group shall review all new construction and modification of PS interlock systems and ensure that the level of protection and reliability is appropriate for the hazards and consistent with PS and BNL requirements. The IWG shall document its reviews using the “PS General Review Form” and the “EMS, FUA, and SAD/ASE Checklist” for Reviews, if applicable. Any changes in the Checklist will result in a memo from the Interlock Working Group Chairman to the PS ESH Manager.

**3.7** The PS Interlock Working Group shall refer to the PS ESH Committee for all interlock systems that involve design features, equipment or protective functions which are outside of established practice at the PS to determine if independent technical review is needed.

#### **4. DOCUMENTATION REQUIRED**

**4.1** Written functional descriptions of radiation interlock systems shall be included in the PS Safety Assessment Documents. These descriptions shall include the hazards protected against, the means of protection, the responses of the system in normal operation, and responses to the system to fault conditions.

**4.2** All circuit schematics and PLC ladder diagrams shall be maintained by the PS Design Group, and control of these documents shall be in accordance with the PS QA program.

**4.3** Written test procedures in sufficient detail to ensure complete functional testing of interlock systems shall be developed by the Accelerator Safety Systems Group, in conjunction with the ESH Group, and maintained by the PS QA group.

#### **5. CONFIGURATION CONTROL**

**5.1** Modification, maintenance or repair work on radiation or laser interlock systems shall be done only under the control of a PS Safety System Work Permit as provided in PS “Safety System Work Permit” procedure, [PS-ESH-PRM-3.4.1](#). Interlock activities with different scope requiring different controls or

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different closeout should have separate safety system work permits. An exception to this requirement is during initial construction of an interlock system, before the interlock system is connected to a correlated interlock chain (e.g. an x-ray beamline before it is connected to x-ray ring interlock chain), and before it is connected to control a radiation source.

**5.2** Interlock connections to external devices such as power supplies or RF switches for the purpose of control of a radiation source shall be marked as part of the interlock system with "Do Not Disturb" warnings and contact information.

## 6. INTERLOCK TESTS

**6.1** All radiation protection interlock and facility Class IV laser interlock tests shall be conducted in accordance with a written test procedure and documented. Proper safeguards must be in place prior to commencing interlock testing that can have an effect on personnel safety.

At times PS Interlock Test Personnel may be required to enter a class IV laser area while the laser is in use to provide guidance to the laser operator for conducting the interlock test. In accordance with ANSI Standards, spectators shall not be permitted in Class IV laser controlled areas unless:

- 6.1.1. *Appropriate approval from the supervisor has been obtained.* Qualified PS ESH Interlock Test Personnel may enter Class IV Laser enclosures under the approval of PS Safety management and the direction of the laser operator acting as a spectator to only observe test results and to provide guidance to the laser operator for completing the interlock test when a safeguard is not in place.
- 6.1.2. *The degree of hazard and avoidance procedure has been explained.* PS Interlock Test Personnel must adhere to the safety instructions provided by the laser operator such as understanding the hazards of the particular laser in use, staying clear of the laser beam path, and not to cross safety boundaries identified by the laser operator.
- 6.1.3. *Appropriate protective measures are taken.* PS Interlock Test Personnel must don appropriate Personnel Protection Equipment (PPE) such as laser safety glasses as instructed by the laser operator.

Note: An eye exam is not required as a spectator. Test personnel must also be proactive to assure that all of the requirements listed above are addressed prior to becoming a spectator.

**6.2** All radiation protection and laser interlocks shall be tested within the 6 month interval specified in "Interlock Safety for High Risk Hazards" requirements within SBMS and the [BNL Radiological Control Manual](#).

**6.3** Following the successful test of a radiation protection or facility Class IV laser interlock system, a notice of next required test date shall be prominently displayed so that Accelerator Operations Group Leader and operations personnel are aware of interlock test status.

**6.4** If a system fails a test or is nonfunctional for other reasons, the radiation source shall be disabled by LOTO. Any exemption from this requirement must be obtained from the Radiological Control Division and the PS Directorate Deputy for Programs or designee (see 7.2).

Accelerator power supplies that are part of the personnel protection interlock system for electrical safety purposes shall be locked/tagged when personnel access is needed to the accelerator areas and the accelerator interlocks are impaired in some manner (e.g. under repair, test period has lapsed). The ESH group will contact the responsible group supervisor and request that the appropriate system be

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Locked/Tagged. A qualified individual from the ESH group will also place a second lock on each device and maintain it during the period of the interlock impairment. The ESH lock shall not be removed until the equipment is needed as part of an interlock test, under controlled conditions, such as written in the interlock test procedures.

**6.5** In the event that a 6 month test requirement cannot be achieved for a radiation or laser interlock system, the Accelerator Operations Group Leader and Safety Officer shall review the issue and confer with the PS ESH Manager or designee. Extensions beyond the 6 month test date shall not occur without approval of the BNL Radiological Control Division Manager, following the “Requirements Management” subject area, for radiological interlock systems and the BNL Laser Safety Officer for Class IV laser interlock systems.

## 7. INTERLOCK BY-PASSING

**7.1** Accelerators, beam lines and lasers shall not be operated with the protective function of interlocks bypassed or defeated except as provided in 7.2. Any attempt to bypass the interlock system except during authorized interlock testing is prohibited. Bypassing door switches, defeating Kirk locks deliberately leaving someone in an interlocked hutch or similar actions are prohibited even when the accelerators are shut down and there appears to be no immediate risk. These violations are treated seriously and could lead to dismissal or loss of research privileges at Photon Sciences. Anyone who is in the position to prevent such actions is obligated to do so.

**7.2** In the rare event of a need justifying the operation of a facility with the interlock by-passed or non-functional, a written procedure must be established which details administrative controls that provides for personnel safety. The procedure must be approved by the Photon Sciences Deputy for Programs or designee after consultation with the RCD Facility Support Representative for radiological interlock systems and the BNL Laser Safety Officer for Class IV laser interlock systems. The requirements within “Interlock Safety for High Risk Hazards” subject area must be met.

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