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LASER INTERLOCK BYPASSED IN VIOLATION OF OPERATING PROCEDURE AT BNL

On April 22, 1999, at the Brookhaven National Laboratory, safety personnel found that a laser interlock for an experiment on one of the beam lines at the National Synchrotron Light Source had been taped closed, which allowed bypassing the intended interlock function. Two visiting researchers (trained and qualified in the use of the laser) had bypassed the interlock to determine if the laser was operating properly. While the interlock, which prevents personnel exposure to the laser beam, was bypassed, the researchers held a screen that was sensitive to the laser wavelength in the path of the laser beam and watched the screen fluoresce. The laser operating procedure clearly states that bypassing the interlock is forbidden. Lasers pose a hazard to the retina, cornea, and lens of the eye. Failure to follow procedures and the bypassing of interlocks can result in personnel injury or damage to equipment. (ORPS Report CH-BH-BNL-NSLS-1999-0003)

The interlock is fixed to the frame of a hutch door. When the hutch door is closed the interlock is closed, allowing the laser shutter inside the hutch to open. If the hutch door is open, the interlock is also open and the laser shutter is closed and cannot be opened. The two researchers taped the interlock so that the hutch door could be open while they entered to verify laser operation.

The laser is a Class IV yttrium aluminum garnet (YAG) laser. YAG is a widely used solid-state crystal composed of yttrium and aluminum oxides and a small amount of the rare earth neodymium. A Class I laser is the least hazardous and a Class IV laser is the most hazardous. Complete definitions for each class are contained in ANSI Z136.1-1993, *American National Standard for the Safe Use of Lasers.*

The National Synchrotron Light Source took the following actions.

- The beam line was locked out and the experiment was terminated.
- The facility privileges of the visiting researchers who bypassed the interlock have been revoked for a three-month period.
- Before the research program involving the laser is restarted, two personnel will be qualified as responsible persons for the operation of the laser and improved operational procedures will be developed and approved.

The actions of the researchers who bypassed the interlock constitute a very serious breach of procedures. This noncompliance has had a significant impact on the operation of the beam line. The lessons learned from this incident will be important for other beam lines at the facility and at other DOE facilities.

NFS has reported other laser safety procedure violations in the Weekly Summary. Some examples follow.

- Weekly Summary 99-13 reported that a safety and health inspector at the Lawrence Livermore National Laboratory performing routine laser interlock inspections discovered a guest researcher operating an open beam, Class II laser without authorization. Investigators determined that the guest had operated the laser with the interlocks bypassed and without an approved project work plan. He had also operated a Class IIIB cadmium/helium laser with the interlocks bypassed and without an approved project work plan. (ORPS Report SAN--LLNL-LLNL-1998-0007)

- Weekly Summary 97-47 reported that experimenters at the Ames Laboratory left a Class IIIB laser operating unattended in violation of laboratory laser safety requirements. Investigators determined that the operator had not taken the mandatory laser and high-voltage safety training. They also determined that although the operator should have performed the operation with the door closed, he propped it open for convenience. (ORPS Report CH--AMES-AMES-1997-0003)

- Weekly Summary 96-48 reported that a security technician at the Lawrence Livermore site was hit in the eyes by the reflected beam from an operating Class IIIB laser when he entered a room to work on an interlock status panel. Investigators determined that a lead experimenter had left the laser on overnight in violation of laboratory laser safety requirements. An ophthalmologist determined that there was no injury to the experimenter's eye. (ORPS Report SAN--LLNL-LLNL-1996-0060)

This event is significant because researchers, charged with the responsibility for laser operations, deviated from operating procedures and bypassed an interlock that was provided for personnel safety. It is important that laser operations are conducted in accordance with approved safe operating procedures. The laser safety officer should approve all operations where interlocks may need to be bypassed (such as maintenance or testing), but only in accordance with procedures.

Managers of facilities using lasers should ensure that laser operators understand hazard control unique to laser operations, and they must enforce adherence to safe operating procedures. Training should include information from ANSI Z136.1-1993. This standard provides guidance for the safe use of lasers and laser systems by defining hazard control measures for each of the four laser classes. Control measures include (1) engineering controls, such as beam housings, beam shutters, and attenuators; (2) administrative controls, such as procedures, warning signs, labels, and training; and (3) personal protective equipment, such as eye wear, gloves, and special clothing. This standard is endorsed in part by DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees,* paragraph 12, "Contractor Requirements Document."