

LASER NEAR MISSES



at Department of Energy Facilities

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LASER NEAR MISSES

- ❑ Events at U.S. Department of Energy contractor facilities
 - ❑ Self-report into a DOE database
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2008 – 2009 SUMMARY

□ 16 incidents

- Interlocks (4)
 - Electrical (3)
 - Procedural compliance (3)
 - Diffuse light exposure (2)
 - Fiber optic exposure (2)
 - Mis-labeled power (1)
 - Fire (1)
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Why track near misses?

- From the previous slide, we see that we might want to focus on:
 - Interlocks
 - Electrical
 - Procedural compliance

 - Individual incidents point out specific problems that need to be addressed.
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1.

Discovery of Unanticipated Interlock Configuration

- ❑ Technicians were performing a Class 4 laser alignment when it was discovered that an interlock did not function as anticipated.

The event:

- ❑ During laser alignment activities, a technician exited the room.
 - ❑ Per design, the lasers became inoperable when he opened the door.
 - ❑ When the door closed, the lasers became operable, which was unanticipated.
 - ❑ The interlock system had been designed to require a sweep button to be pushed before the system would become operable, but this did not happen.
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Discovery of Unanticipated Interlock Configuration

- ☐ Personnel were wearing laser safety glasses.
- ☐ No personal injuries occurred.

Cause:

- ☐ The interlock systems were verified to work according to two procedures, but they were not tested for deviating from the procedures.
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2.

Maintenance Technicians enter a Laser Laboratory and trip Door Safety Interlocks

- ❑ Class 4 laser running in an “open beam” configuration.
 - ❑ A laser operator stepped out of the laboratory for a few minutes.
 - ❑ Safety interlocks on both doors.
 - ❑ Upon returning he found that the laser safety interlocks had been tripped.
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Maintenance Technicians enter a Laser Laboratory and trip Door Safety Interlocks

1st Entry:

- ❑ Maintenance technicians had entered the lab to install a cable tray.
 - ❑ They entered the lab while the "LASER IN USE" sign was illuminated and the laser was active.
 - ❑ They were wearing regular safety glasses, not laser protective eyewear.
 - ❑ The door safety interlock tripped, causing the laser shutter to close.
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Maintenance Technicians enter a Laser Laboratory and trip Door Safety Interlocks

2nd Entry:

- ❑ This time, the door interlock did not activate because the laser operator had just entered the laboratory and had invoked a 30-second time delay on the door interlock.
 - ❑ Because the technicians opened the other door at the same time, the door interlocks were bypassed, the laser shutters did not close, and laser energy was being emitted on the optical table.
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Maintenance Technicians enter a Laser Laboratory and trip Door Safety Interlocks

Technician explanation:

- ❑ The "LASER IN USE" sign seemed to have been illuminated for weeks.
 - ❑ The technicians thought that potentially hazardous experiments were not typically conducted after normal business hours.
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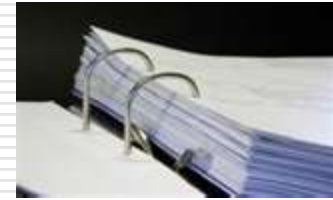
3. Electrical Shocks (2 similar incidents)



- ❑ A worker received a shock while removing a plug from a hard-wired, permanently installed power strip.
- ❑ While working the plug loose, the worker's fingers came into contact with the exposed metal prong.

Cause:

- ❑ The power strip was located underneath a laser optic table, and in close proximity to experimental equipment which led the worker to unplug the apparatus without maintaining visual contact with the plug.
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4. Laser Operation Procedural Weakness

- ❑ A researcher and a technician were working in the Laser Laboratory when the laser was prematurely fired.
 - ❑ Upon hearing the audible laser firing message (which precedes the firing of the laser), the two employees in the laboratory immediately opened the interlocked door to the hallway which is intended to terminate the laser firing sequence before the laser fires.
 - ❑ The door was opened too late to prevent the laser from firing and it is believed that some laser light was allowed to enter the room.
 - ❑ The presence of a beam block resulted in a blockage of the majority of the laser power to the target chamber where the employees were located.
 - ❑ The employees were wearing laser safety eyewear.
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Laser Operation Procedural Weakness

Causes:

- ❑ The control room operator believed he received the "all clear" message from the employees in the Laser Lab, but confusion with communications may have led to the inadvertent firing of the laser.
 - ❑ The initial communication process, which occurs by radio, was halted in this particular experiment. The extra communication that was needed to resume the sequence may have been unclear.
 - ❑ Due to distractions (both in the control room and the target bay), the communication step in the procedure for verifying that the room was all clear was omitted (or erroneously assumed to be completed).
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5.

Employee exposures to Diffuse Laser Light

- ❑ Two employees reported seeing laser light from a Class 4 laser.
 - ❑ The employees were reviewing the configuration of detectors in an adjacent room.
 - ❑ When they looked into an electron beam transport tube, they described seeing a green flickering light coming from the other room.
 - ❑ No mechanism (i.e., gate valve on the tube) was in use to block the electron beam transport tube since the focused laser beam was not in the direct line-of-sight of the electron beam transport tube.
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Employee exposures to Diffuse Laser Light

- ❑ The employees were evaluated by an ophthalmologist who concluded that no injuries were sustained.
- ❑ Laser power meter readings confirmed that the level/intensity of light available to the affected employees was negligible (nothing detected above 1 microwatt).

Cause:

- ❑ The potential for the laser light to enter an adjacent room had not been fully evaluated.
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6. Fiber Optic Laser Incident



- ❑ Two workers were moving fiber cables when they inadvertently viewed a green light emitting from one of the fiber cable ends.
 - ❑ Two laser operations were being performed simultaneously:
 - Workers were in one room attempting to connect the fiber optics to the patch panel.
 - Laser personnel were in another room aligning their interferometer using the attenuated laser beam.
 - ❑ Following discovery of the laser light, the laser system was de-energized.
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Fiber Optic Laser Incident

- ❑ The output from the laser into the fiber optic was estimated to be less than 600 microwatts (Class 2).
- ❑ Medical evaluation concluded the workers did not sustain any eye injuries.

Causes (7):

- ❑ The laser operator had inadvertently left the fiber optic connected to the laser beam.
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Fiber Optic Laser Incident - causes

- ❑ The only control to keep the laser light out of this pathway was administrative (a checklist), which relied on the laser operator to disconnect or block the laser light from the input fiber.
 - However, the checklist had no step to ensure the operator disconnected or blocked the laser light.
 - ❑ There was no labeling of the fiber optic cables, patch panel connections or junction boxes as required.
 - ❑ The laser enclosure lid had no safety interlocks as required.
 - ❑ Neither the workers nor the laser operators had laser system key control during their work activities.
 - ❑ The workers were unaware of laser operations in the laser room (no communication).
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7.

Labeled Class 2 Laser measured as Class 3B Output



- ❑ A labeled Class 2 laser, used in a high resolution ruby fluorescence high pressure measurement system, had its beam power level measured and found to be in the Class 3B power output range.
- ❑ The laser was supposed to have a nominal output no greater than 1 mW, but the measured output was 18 mW.



Labeled Class 2 Laser measured as Class 3B Output

- ❑ Optiprex 532 nm laser systems procured before 2007 may be at a higher class power level than advertised.
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The Value of Tracking Near Misses

- ☐ Organizations addressed these specific issues & fixed them.
 - ☐ Avoided future injuries?
 - In 2010, no incidents or near misses
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