Lesson Learned Briefing

No.: LL11-0024

Title: Laser Configuration Control has value-SLAC incident

Event: Other Facility Event

Event Date: 05/25/2011

Category: ES&H - Laser Safety

Summary:
Lessons Learned Statement:
Configuration control, managing beams and laser activity has always been a part of laser lab activity. The more users, the more set up, the more important configuration control becomes. This will protect equipment, as well as staff.

Discussion:
On May 25, 2011, a Stanford graduate student, who is a qualified laser operator, noticed an exposed beam from a Ti:sapphire laser oscillator on his shirt sleeve while placing an object on an optical table in a research laser lab. The laser safety system had been set to "Class 1 Mode" at the end of the previous day, which means that no laser beam should have been present. In this mode, access is limited to qualified personnel, and all laser beams are required to be enclosed. In this case, laser eyewear PPE is not required, and as such, the operator was wearing none. After viewing

the unexpected beam, he took immediate steps to disable any potential hazard. A beam block was immediately put into place. He notified the supervisor, and he then disabled laser operation by removing the power supply key and notifying the SLAC LSO. There were no injuries and no property damage.

Detailed description of the incident:
On the day prior to the incident, four laser operators were performing routine laser work when they discovered that an optic on the table needed to be repositioned. The lead operator for the work is a SLAC employee. Two of the other operators are Stanford graduate students, who had only recently started working in the laser lab. The fourth laser operator is an experienced laser operator in a different facility, who was providing assistance, but left the lab prior to the safety shutter being removed.

The lead operator had previously discussed the scope of work with the laboratory supervisor for the week; however, during the course of the laser alignment, it was determined that an optic needed to be moved. The operators discussed the situation and determined that the best position for it required that a laser safety shutter be relocated within the laser safety shutter enclosure. None of the operators realized that as part of the laser safety system (LSS) configuration they were required to get additional supervisor approval to relocate the shutter. The shutter was subsequently removed from the beam path. Alignment of the optic proceeded, otherwise following the appropriate standard operating procedures that included the use of "Maintenance Mode" of the LSS and temporary beam blocks

to contain the laser beam. In "Maintenance Mode" laser beams may be present and laser eyewear PPE is required. In this mode, it is assumed that the shutters may not provide complete protection, so in the event of an interlock trip the laser power supplies are disabled. At the end of the day, the LSS was placed into "Class 1 Mode". The student operators clearly stated that they did not put the LSS into Class 1 mode at this time, while the lead operator does not remember putting it into Class 1 mode, but stated it was possible that he did so. The investigation team proceeded with the assumption that this was done by the lead operator. However, when this was done, the required laser safety shutter was still removed from the beam path and two required Class 1 enclosure panels were not in place (top cover and one side shield of the shutter enclosure removed). In "Class 1 Mode" the laboratory access is still restricted to laser operators, but all laser beams are supposed to be enclosed and inaccessible. It was a common practice to put the LSS in "Class 1 Mode" at the end of the day when the laser was on but not in use, which may be why the LSS was incorrectly put to this mode at this.

The following morning is when the graduate student operator entered the lab alone in "Class 1 Mode". The covers were removed when the student arrived, but the student did not immediately realize that this was not consistent with "Class 1 Mode" operations. It was only once he noticed the laser beam striking his arm that he realized that something was not right.

Analysis:
It was determined that the direct cause of the exposed beam

was that a required laser safety shutter had been moved on the previous day to accommodate commissioning of a new optical beam path. Laser operators made a laser safety configuration change without defining and following an appropriate work plan. The upshot of which is that a laser safety shutter was removed from the beam path and the full functionality of the laser safety system was not restored. The shutter was not replaced and the covers to the shutter enclosure were removed when the system was put into "Class 1 Mode". This ultimately resulted in a laser beam being present in an uncovered enclosure during a (restricted) operating mode when no beam should have been present. The beam was otherwise confined within two enclosures on the optical table; however, the enclosures were not covered allowing for access to the beam. See attached images.

Overall, the investigation team found that better safety configuration control and training would likely have prevented the event from occurring. This event underscores the need to define and follow good procedures that emphasize focusing on the task at hand and the importance of on-the- job training. Moreover, the team found that training and procedures should explicitly include safe methods for zero energy verification.

Specifically, the investigation team identified several root causes for the incident:
1. One potential causal factor involved the initial placement of the shutter. Had the shutter been installed closer to the source it may not have required that it be relocated. The team was split on whether this was a root or contributing

cause.

2. Prior to removing the shutters, the operators were unaware of the need to seek additional supervisor approval to perform the desired task. The operators did not recognize that the planned work was outside of the approved safety configuration scope and laser operation. Furthermore, the shutter was not labeled either as a laser safety device or a restricted item, although the cover to the shutter enclosure had a laser safety device label that indicated not to remove unless in "Maintenance Mode."

3. While the supervisor has indicated that he would have approved the reconfiguration, the additional discussion would likely have resulted in an adequate work plan. Contributing factors were:
a) The laser safety system SOP was never referred to, in part because the format makes it difficult to find the appropriate information.
b) On the job training (OJT) did not make it clear that this type of change was not in the scope of the approved work.

4. The lid to the shutter enclosure and the shutter were both removed in "Maintenance Mode." Attention was given to the wrong issue: finishing the optics alignment work (also in "Maintenance Mode"), which resulted in the failure to complete the laser safety reconfiguration. The incident would likely not have occurred if the operators performed their task in a timely manner and verified that the shutter was operating as intended.
a) Contributing factors may have included an assumption of completion, potentially due to a mental lapse or infrequently

performed steps.

5. Finally, the system was incorrectly placed into ?Class 1 Mode? due to a failure to perform zero energy verification and ensure that the required Class 1 covers were in place. Had the operator verified the state of the system, he would have realized that the covers were off. It is possible that he would have also realized that the shutter was out of the beam and the system could have been put back in working order at this point. In addition, had the operator immediately verified the state of the system upon entering the room in Class 1 mode, he could have identified the potential for an open beam path in a more controlled manner.

Actions taken to address the issue:

Immediate corrective actions:
1. New procedures for changing to "Class 1 Mode" were posted locally at the LSS control panel. The new procedures (checklist) were simplified and explicitly included a zero energy verification step.

2. The shutter was repositioned as close to the output of the laser as practical, and a new shutter enclosure is being designed to enclose only the shutter and a minimum number of optics.

3. The shutter was labeled as a laser safety configuration device that cannot be moved without supervisor approval. The label was positioned over the mounting screws to add an additional barrier to future removal.

Corrective actions that SLAC will implement:
1. The Laser Safety Officer (LSO) will review and evaluate the need to update lab policy on laser safety configuration control. This includes identifying critical safety items and design considerations for their labeling, placement and securing method (for example requiring a special tool to remove), as well as change control and potential documentation requirements.

2. Update On-the-job training to include:
a) Identification of laser safety components and restrictions on their reconfiguration.
b) Emphasis on importance of verification and safe ways to perform it.
c) Demonstration of changing modes.

3. Rewrite SOP to make information more accessible and to include explicit verification steps to laser safety configuration changes.

4. Post new procedures for going to Class 1 mode at point of use, which includes a specific zero energy verification step.

5. The Laser Safety Officer will review, with input from the Laser Safety Committee, requirements for Class 1 operation mode. The review will include which Class 1 enclosure covers should be interlocked and in which circumstances unattended Class 1 operation is permitted. The Laser Safety Officer will develop associated lessons learn to distribute to SLAC laser personnel, which will include an evaluation of extent of condition.

Uploaded documents/attachments:

ESH-131_LaserAccidents-LessonsLearned-NearMiss.ppt

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