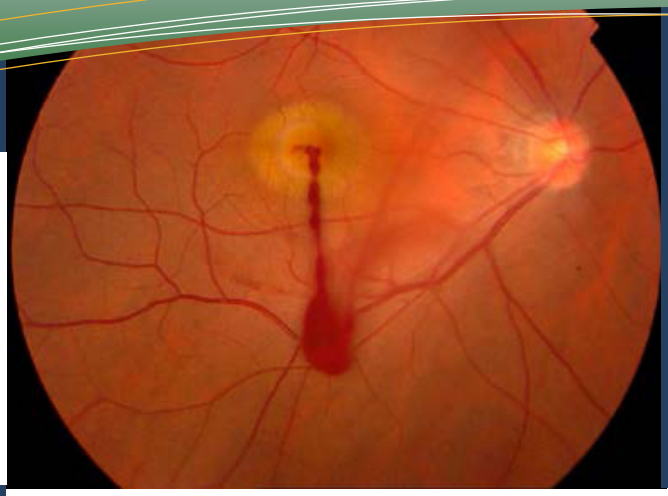
Volume 1
Issue 2

Laser Lessons News Letter



This issue

"It is better to pause work for a moment and get it right rather than regret what can't be fixed when all goes wrong. A laser accident happens quicker than the blink of an eye, but what results could last a lifetime."

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Introduction

Welcome to the second edition of the Institutional Laser Safety Newsletter. This issue covers a couple of recent laser accidents. Though LLNL has been very fortunate and has not had any serious laser exposure safety incidents, reports of near misses and accidents are on the rise at other facilities. Careful review of these incidents provides an opportunity for us to learn and prevent injuries here at the Laboratory.

As you will see in the incidents discussed, there were multiple levels of breakdown that led to these accidents. The predominant issues leading up to these exposures were the reliance on workers and "human factors" over strict engineered controls. It is human nature to relax and take things (i.e., safety) for granted when all is going well. The further an off normal or accident is behind you, the more complacent you may become to addressing safety.

Now is the time to refocus on safety to ensure that you are not placing your co-workers or yourself in an unsafe situation. Our safety program and our reputation only are as good as our most recent accident or near miss. World Class Safety=World Class Research!

Accidents

In the last issue we covered a near miss that could have easily resulted in an injury. Many of these off-normal reports come to the same conclusion. That is, workers have allowed the failure of several layers of protection either through expedience or being unaware of the potential hazard. These incidents follow the same pattern. As you read, think about shortcuts that you may take in your everyday tasks and how easily those could turn into an accident and an injury.

Incident #1

The first scenario occurred in December 2011 in the R&D Department of a commercial laser manufacturer. Here a worker was attempting to measure the output power loss of lasers through optical fibers as a function of a decrease in the bend radius of the fibers. There were 9 laser units combined into 31 fibers operating at 915nm with 950 watts of total laser optical power. Figure 1 shows the fiber optic setup.

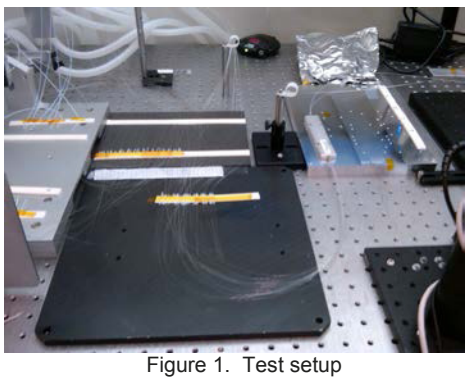
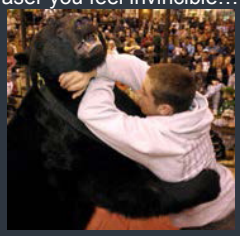


Figure 1. Test setup

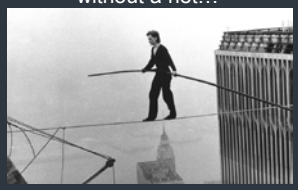
The test setup was a 36"x 96" bread board laser table with laser fibers located on the left side and power measurement on the right.

Don't wear an eye patch!

When you get the keys to a new laser you feel invincible…

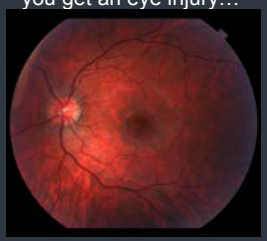


When you feel invincible you work without a net…



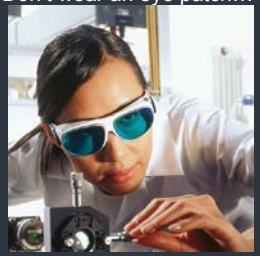
When you work without a net you don't wear your eyewear…

When you don't wear your eyewear you get an eye injury…



When you get an eye injury you wear an eye patch…

Don't wear an eye patch…



BE SAFE!

Figure 2. Worker position

Incident #1 (cont.)

The table was equipped with two "emergency-off" buttons within arm's reach of the worker and an interlocking photo diode to shut down during preprogrammed power fluctuations. One of the emergency-off buttons was depressed to shut down the laser.

This operation was fairly simplistic in that it required the worker to:

1. Adjust the fiber optics manually to designated coil diameter.
2. Turn the laser on.
3. Record power output.
4. Turn the laser off and repeat steps.

In order to perform this task, the worker was required to lean over the test rig (Figure 2). Much of the operation safety relied on Administrative Controls. With that, human factors took over. The worker determined that it was simply easier to make adjustments to the fiber coil with the laser left on.

During the action, more laser radiation escaped out of the coiled fiber as the bend ratio increased. The worker's smock came in contact with the fibers during the process and immediately melted, igniting the worker's sweater (Figure 3).

There were many contributing factors that led to this accident:

1. A hazard analysis was not performed.
2. The worker did not follow the procedure to turn off the laser prior to making adjustments to the fiber bend ratio.
3. The photodiode interlock was not connected during the experiment. The worker did not receive the Laser Safety Officer's approval to operate in this manner.
4. The set up required the worker to lean over the fibers to make adjustments.
5. No barrier was placed in front of the fiber coil.
6. The worker was new to the area and new to R&D type work.
7. The worker was only familiar with low power lasers through fiber optics and did not receive an introduction to this operation prior to commencing work activities.
8. The worker did not use the test operation checklist and could not produce a Standard Operating Procedure.

Figure 3. Melted smock

When thinking of the hazards posed by a high-power laser, many workers will not give a second thought to the thermal or skin effects. They believe that their laser protective eyewear provides them an invincible shield. This is far from the truth.

In situations where the Optical Density (OD) requirements are greater than OD7, it is much better to enclose the beam or to remove yourself from the area and operate the laser remotely. PPE will provide your eyes protection for a brief period while the laser is burning through the filter-media. Your skin though is generally not protected. This is true even if you are wearing tightly woven clothing, as in this accident.

When working with high powered lasers, you need to pay close attention to what you are doing and all of the different hazards that may be present. Take a moment and think about what you are going to do before you do it and ask yourself if what you are about to do is safe.

It is better to pause work for a moment and get it right than to regret what can't be fixed when all goes wrong. A laser accident happens quicker than the blink of an eye, but what results could last a lifetime.

Incident #2

The second incident occurred on August 30, 2011 at a DOE Laboratory where a technician received 2nd degree burns to the middle and ring fingers of his left hand while performing a preventive maintenance (PM) procedure on a Class IV industrial laser. The task required placement of a "target" in the beam path to verify mirror alignment. The technician, believing the laser was in a safe mode, reached into the beam pathway to place the target, saw a flash, and immediately withdrew his hand.

Three technicians were assigned to perform an extended run time PM on the laser. A pre-job briefing was held August 29, 2011 by the acting foreman prior to the technicians starting the PM.

They had completed several steps of the work by the end of the day. The laser systems were placed under LOTO and the internal optics were cleaned or replaced. The LOTO was removed the next morning and the technicians prepared to take a diagnostic shot inside the internal optics.

The laser was powered up and the person in charge (PIC)

Figure 4. Laser pendant

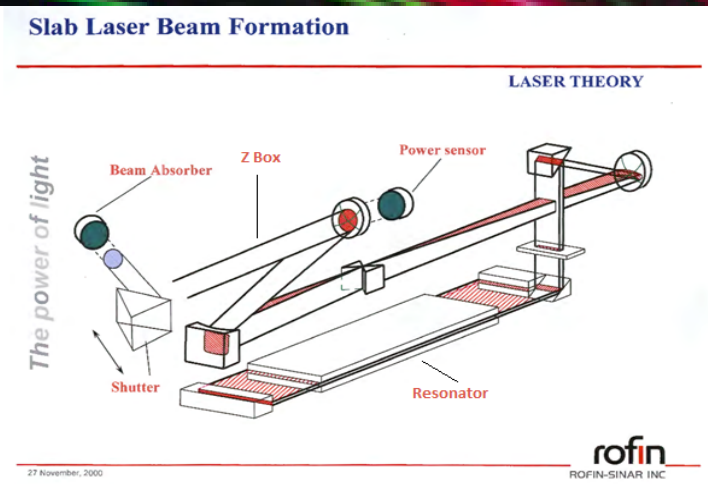


Figure 5. Machine diagram

selected the "Mirror Alignment" program from the human machine interface (HMI) screen. They enabled the pendent and pressed the "Cycle Start" button (Figure 4). The technicians believed that the laser was in "simmer" mode at this point and that no beam was being generated out of the resonator (Figure 5). A beam was being generated in the "Mirror Alignment" program when the "Cycle Start" button was pressed. They decided to check the aperture target and see if they were aligned at that location. One of the technicians reached to place the target at the end of the Z box and a "flash" occurred (Figure 6). The technician immediately retracted his hand with the target.

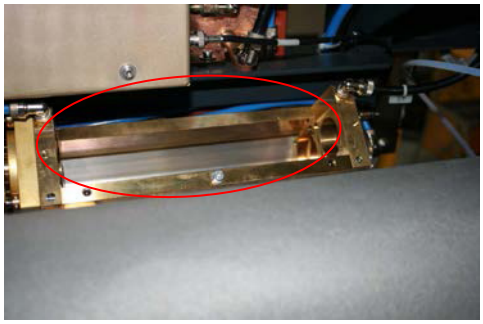


Figure 6. Z box

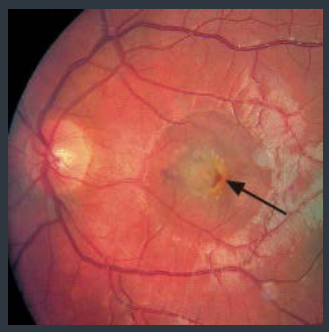
The PIC turned off the high voltage (HV) at the pendent. The Foreman and Supervisor were informed of the incident and the injured technician was escorted to the medical facility. The technician's left middle and ring finger tips received 2nd degree burns. Here again, as in the first incident, there were several layers of failure leading to this accident.

The contributing factors were:

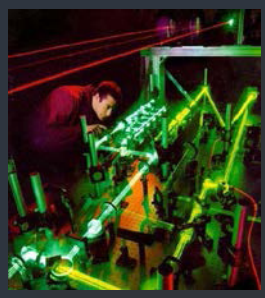
1. Inadequate training. This equipment was composed of two separate devices. The laser beam generator was built by one vendor while the beam delivery was built by another. This made the machine interface of the beam generator confusing to the technicians involved. Thus, they misunderstood the "simmer" mode and believed that no beam was present. This is because they were used to working on the delivery side where "simmer" meant the beam was blocked upstream by a shutter.
2. Inadequate hazard identification. This process relied on the skill, training, and experience of the technicians and did not identify important safety rules established by the manufacturer. Because of this, the workers lacked specific controls to work safely.
3. The technicians performed portions of the task from memory rather than referencing the work order or the vendor's

Laser Accidents

The largest recorded laser accident occurred outside of Moscow, Russia where a laser light show permanently injured 12 individuals.



60% of all laser accidents occur during laser alignment/ beam manipulation.



The primary cause of a laser eye injury is the lack of eyewear.

The individual who is at greatest risk for a laser injury is the worker with >15 years experience and strong familiarity with the task at hand.

BE SAFE!

Incident #2 (cont.)

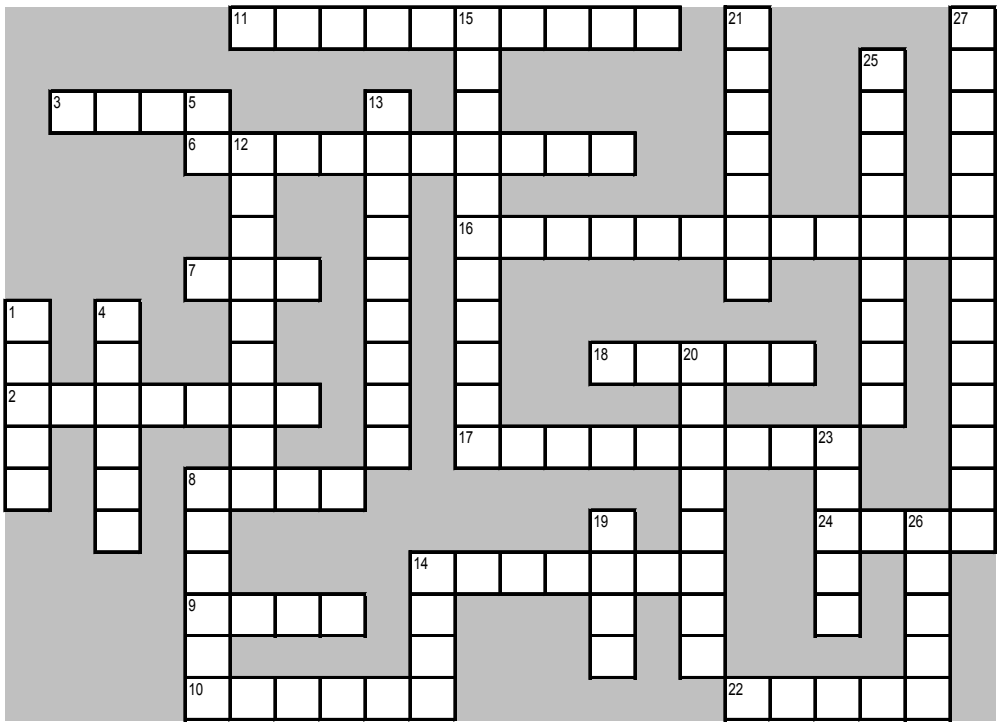
operator manual. Key safety steps (turn off the HV prior to placing any part of the body in the beam path) were not performed correctly. The technicians had developed a level of confidence based on their experience with the lasers. In some cases, this confidence led to a departure from safe work practices encouraged at the vendor training. Vendor training encouraged the practice of inserting a piece of thermal paper into the beam path to verify the beam was not present prior to placing any part of the body in the beam path. This practice has not been followed for some time.

4. During the hazard assessment, the support team (Safety, the Laboratory Site Office, and Engineering) relied on the technicians' skill, training, and experience to perform the tasks safely. There was also no follow up once work began to ensure the actions taken by the workers were appropriate for the level of risk involved.

As you can see in the two incidents discussed, there were multiple layers of breakdown. The accidents were the result of a total breakdown in the team. From management's review and implementation of controls, or lack thereof, down to the workers' lack of understanding and ignorant comfort for the task at hand.

Take a moment to review your own work area. Speak up if something doesn't make sense or just doesn't feel right. Complete a thorough dry run on a new process to make sure the whole team understands what is expected and that it is safe. Think about what you are doing everyday and work smart so you don't speak those famous last words, "I knew better." Controls that are in place are there, most likely, because of the injury sustained by a previous worker.

Crossword Puzzle



DOWN

1. The U.S. Supreme Court credited him with the invention of the radio.
4. _____ Sneeze Reflex is a genetic trait which causes a person to sneeze uncontrollably when exposed to bright light.
8. There are more of these in NIF than anywhere else in the world.
12. This is the layer of the skin where the tanning process takes place.
13. This spacecraft exchanged laser pulses with an earth-based observatory from 15 million miles away in 2005.
14. The light conduction portion of an optical fiber.
15. The fear of light.
19. Columbus' favorite ship.
20. This is required from the FDA to conduct a laser light show.
21. A class 2 laser is <1mW and in the _____ portion of the spectrum.
23. The human eye perceives this color the greatest.
25. Laser eye injuries occur the most during this phase of operation.
26. He published the first paper coining the term LASER.
27. A lightweight material used to manufacture laser protective lenses.

ACROSS

2. A blind spot is described as this.
3. The year that #1 Down occurred.
6. Laser protective eyewear works on the premise of absorption and ___.
7. Charged with regulating the manufacture and sale of laser products.
8. Charged with protecting the safety and health of U.S. workers.
9. The colored portion of the eye perforated by the pupil.
10. A representative part of the whole.
11. Polycarbonate lenses provide protection through the ____ of energy.
14. This type of label is used on a Class 2 laser.
16. Where was the world's first oil well drilled?
17. He placed the first retro-reflectors on the moon.
18. Contains the greatest concentration of cones in the eye.
22. The brain compensates for the _____ spot in each eye caused by the optic disc.
24. This laser system in NIF provides side illumination of the final optics for damage inspection.