Recent Laser Incidents and Lessons Learned at DOE Labs since 2024

Presented to Department of Energy Laser Safety Officer Workshop

May 21, 2026

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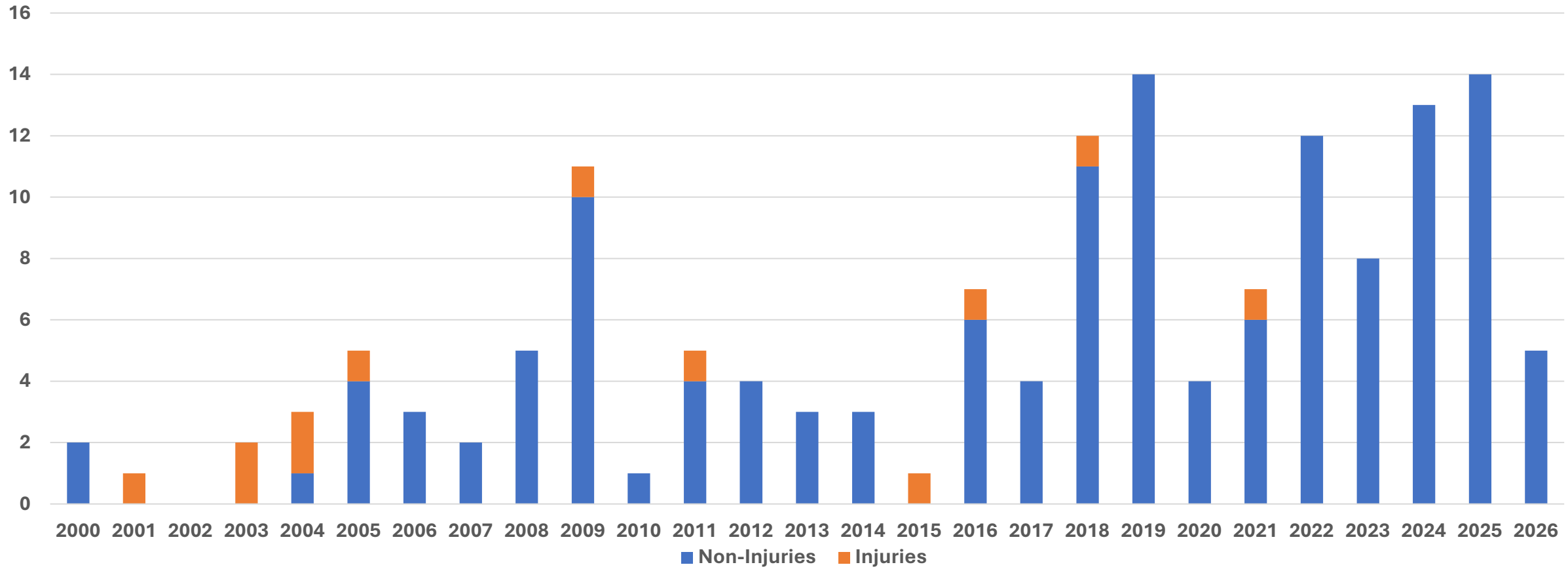
Prepared by LLNL under Contract DE-AC52-07NA27344.

DOE Laser-related Off-normal Events (2000-2026)



DOE Laser-related Off-normal Events (2024-2026)

Site	M/Y	Description of Event
LLNL	**3/24**	**Subcontractor brought inadequate LPE for scheduled work**
LLNL	4/24	**Worker reported burning through a plastic dust cap with a non authorized Class 4 laser**
LLNL	4/24	Laser work, including alignment activities, was performed off-site without authorization
LLNL	7/24	Worker accidentally turns on a Class 3B laser with no LPE
SNL	**8/24**	**Worker was adjusting laser power, via computer, laser unexpectedly emitted a high-power beam that reflected off a filter and damaged a laser safety curtain**
LLNL	8/24	Worker was exposed to high output blue LED source
LLNL	**8/24**	**Worker found using a Class 3B laser pointer in auditorium**
SNL	**10/24**	**Worker reached across table and exposed to Class 3B laser through upward directed beam splitter while not wearing LPE**
SLAC	12/24	Worker mistakenly dismantles laser enclosure and shutters that was out of scope of work.

Site	M/Y	Description of Event
NLR	1/25	Worker was using a laser scriber with regular safety glasses on.
LLNL	3/25	Worker fails to post room prior to energizing laser power supply
SNL	**3/25**	**A subcontractor was found in an LCA operating a Class 3B laser with no LPE**
SLAC	4/25	Worker was exposed to a stray specular reflections from a Class 4 harmonics generation setup
LLNL	**5/25**	**A worker adjusting shutter timing ended up in a position putting eyes at beam height for and extended period**
PPPL	7/25	An intern experienced discomfort at an offsite facility while using a spectroscopy system
LLNL	8/25	Worker reported being exposed to a UV/blue incoherent light source
LBL	**8/25**	**An xTools F1 Ultra Laser Mill was found to be misclassified by the user as Class 1**
SNL	8/25	While performing vacuum leak checks, optical fibers were disconnected from the patch panel. The laser was in a configuration where it could have sent Class 4 laser light through the fibers.
LBL	**9/25**	**A 100W laser engraver arrived at the facility and was found to be non-compliant with no labels or information on the laser**
LLNL	9/25	A Class 4 laser was found in operation while not being connected to the LCAs interlock system

Site	M/Y	Description of Event
LLNL	10/25	While workers were recommissioning a laser system, it was discovered that the seed laser was not placed in a safe mode when the enclosure interlock was tripped
LBL	**10/25**	**A labeled Class 2 laser pointer reflected off a monitor surface and struck a spectator. It was discovered that the laser was actually a Class 3B (42mW green)**
LLNL	10/25	While performing an interlock check, worker was found not wearing correct LPE.
LLNL	2/26	After a Class 4 laser was found in operation while not connected to the LCA interlock, further investigation found many other issues in the lab space and a stop work was initiated
LLNL	**3/26**	**A non-interlocked rollup door was opened while a Class 4 laser was in operation**
SNL	**3/26**	**A worker was exposed to a Class 3B fiber visual fault locator with output ≥50mW**
LLNL	3/26	An incoherent filtered LPE was found in a laser lab
LLNL	**5/26**	**Subcontractor brought inadequate LPE for scheduled work**

Lawrence Livermore National Laboratory– April 2024

- Worker brought a Class 4, 2-watt 1550nm laser into lab for use on a project.
- Laser was not authorized to be used under the Work Control Document.
- Class 1 (closed loop) laser work was authorized.
- Worker was not getting the proper signal so attempted to troubleshoot problem.
- Worker disconnected fiber end and, at some point, noticed that the plastic dust cap was burned.

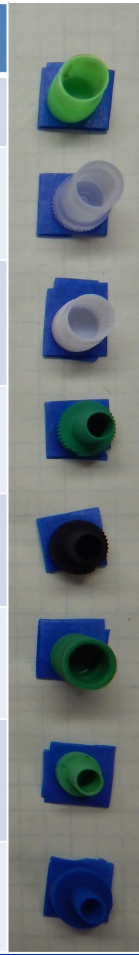
- Work was NOT paused nor stopped, and the incident was not reported until some time later.

Class 4 open beam operations were not authorized!

What Went Wrong/Contributing Factors

- Laser was not authorized to be used in this space.
- Troubleshooting and scope-creep introduced hazards (Class 4) beyond approved work control document (Class 1).
- Worker thought that the cap burn was “no big deal” because fiber was directed at the floor.
- Worker did not stop or pause work.
- Plastic dust cap was used as a barrier.

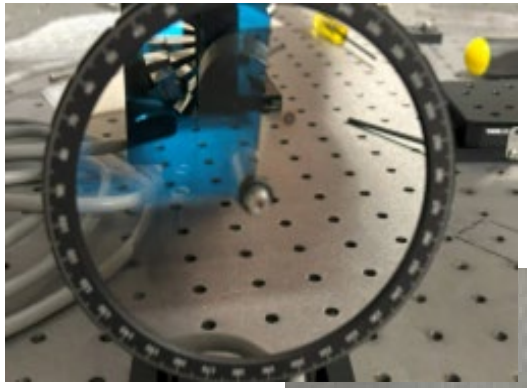
Transmittance
37.5%
43.3%
41.8%
15.3%
0%
0%
0%
3.4%



Fiber optic dust caps are not laser barriers!

Sandia National Laboratories – August 2024

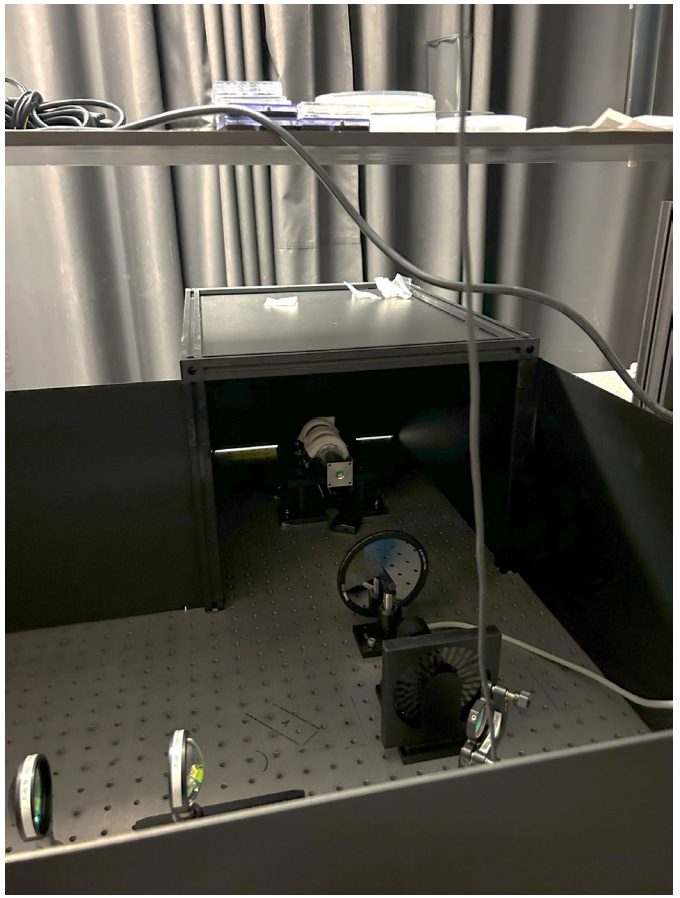
- Worker was adjusting the pulse repetition rate of a laser using a software graphical user interface (GUI). The software malfunctioned and caused the laser to switch from pulsed to continuous wave (CW) mode.
- A high-power CW beam reflected off a neutral density filter.
- This resulted in damage to the neutral density filter and burned a hole into the laser safety curtain surrounding the laser table.



Be aware of and block potential stray reflections in beam path!

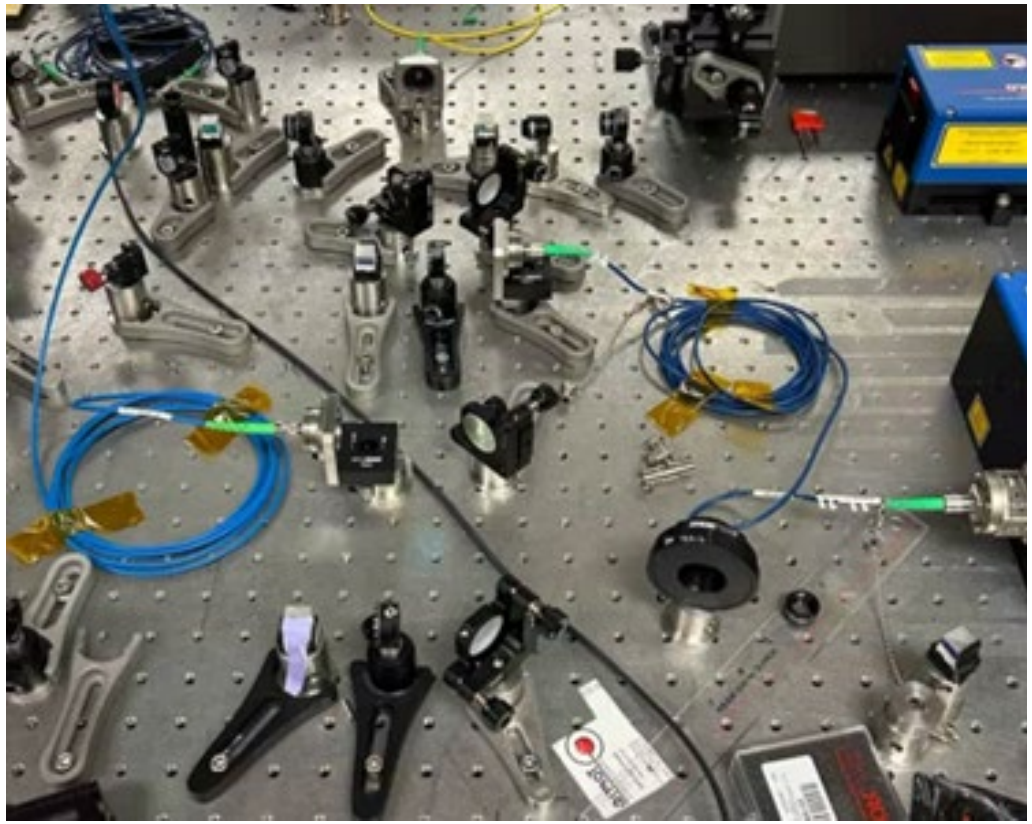
What Went Wrong/Contributing Factors

- Beam path not contained to laser table, which allowed the laser curtain to be burned due to reflection from neutral density filter.
- Graphical user interface (GUI) was out of date. The manufacturer knew of the software issues but failed to inform purchaser.
- User manual was not available.



Ensure User Manuals are available, and software is kept up to date!

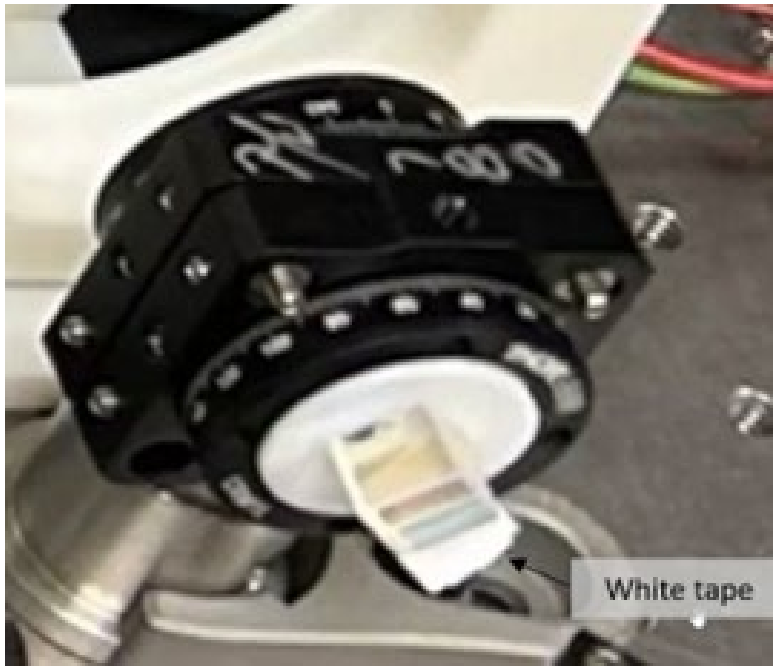
Sandia National Laboratories – October 2024



- Worker was training to operate a new laser system.
- The worker reached across table to adjust an optic and exposed to Class 3B laser through upward directed beam splitter while not wearing LPE.
- The polarizing beam splitter allowed the laser beam to leave the horizontal plane of the optical table.

Understand and control your optical path!

What Went Wrong/Contributing Factors

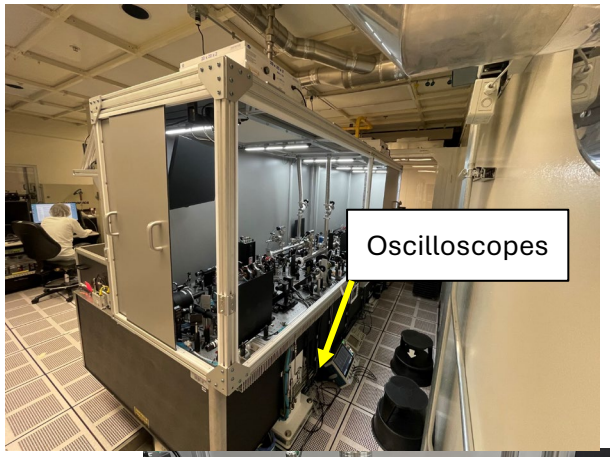


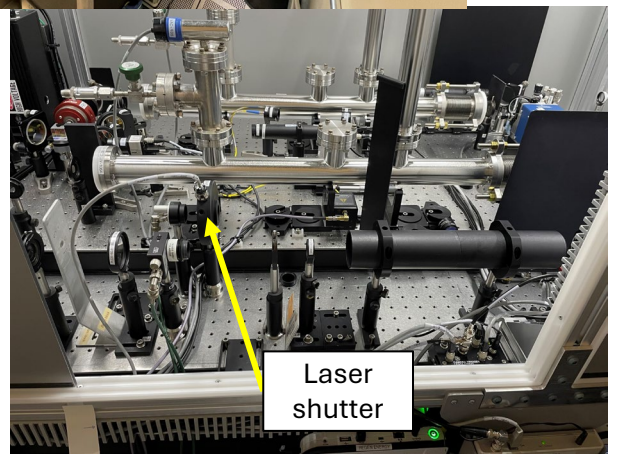
- Previous user of the system noticed a bright spot on the optical table from downward directed 740nm laser beam and placed tape on the splitter.
- This tape allowed some of the laser light to reflect upward out of the splitter.
- A hazard analysis was not performed for the new laser system.

Communicate any changes or potential issues with a beam path configuration!

Lawrence Livermore National Laboratory – May 2025

- Worker was adjusting timing on a shutter
  - Laser #1- 12mW output 655nm pulses being chopped to 1.5ms at 50% duty cycle (output 6mW)
  - Laser #2- SNL1.5 Regen,1064nm, 0.5 ns pulse length, 300Hz rep rate, 4mJ
- Workers diagnostic equipment (oscilloscope) was placed on floor.
- Worker required to observe shutter position and oscilloscope for task
- Worker finds step stools to sit on for comfort.
- Worker complains of eye pain

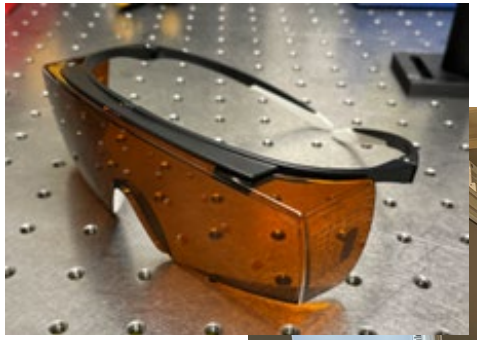




Conduct a full job review no matter how small the task may seem!

What Went Wrong/Contributing Factors

- Laser work and timing work was authorized under separate work control documents.
- Job was understood to be to be “quick”.
- Worker’s seating brought them into the plane of the laser beam.
- Worker’s LPE was ill-fitting with clean room mask on.
- Oscilloscope located lower than beam path
- Should cameras have been used?



Asking “What if” may have prevented this!

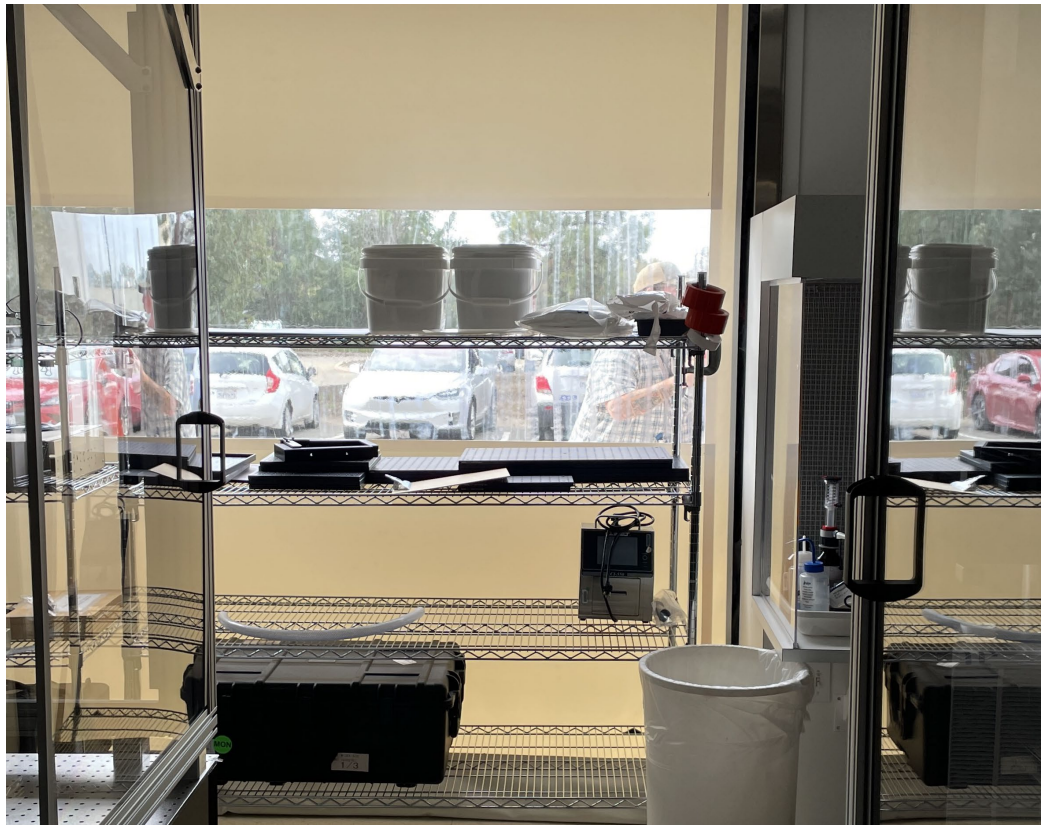
Lawrence Berkeley National Laboratory – Oct. 2025

- An xTools F1 Ultra Laser Mill was found to be misclassified by the user as Class 1.
- F1 Ultra comes in two versions:
  - Model: MXF-K002-B20 is Class 4
  - Model: MXF-K002-001 is Class 1
- The purchaser must specifically ask for the Class 1 model.

Laser cutters/engravers are the new laser pointers!

Lawrence Livermore National Laboratory – Feb. 2026

- Worker was conducting laser work in an established laser laboratory.
- Worker placed a beam block in the beam path and left the lab space for a short time.
- Safety Interlock System was activated showing laser operations in progress.
- Crafts Personnel performed preventative maintenance on a rollup door to the space and opened the door
- Worker returned to the lab space and noticed the room was very bright.
- The laser remained operating.



One non-interlocked door, one lock, one key, held by one employee who made one assumption - multiple points of failure

What Went Wrong/Contributing Factors

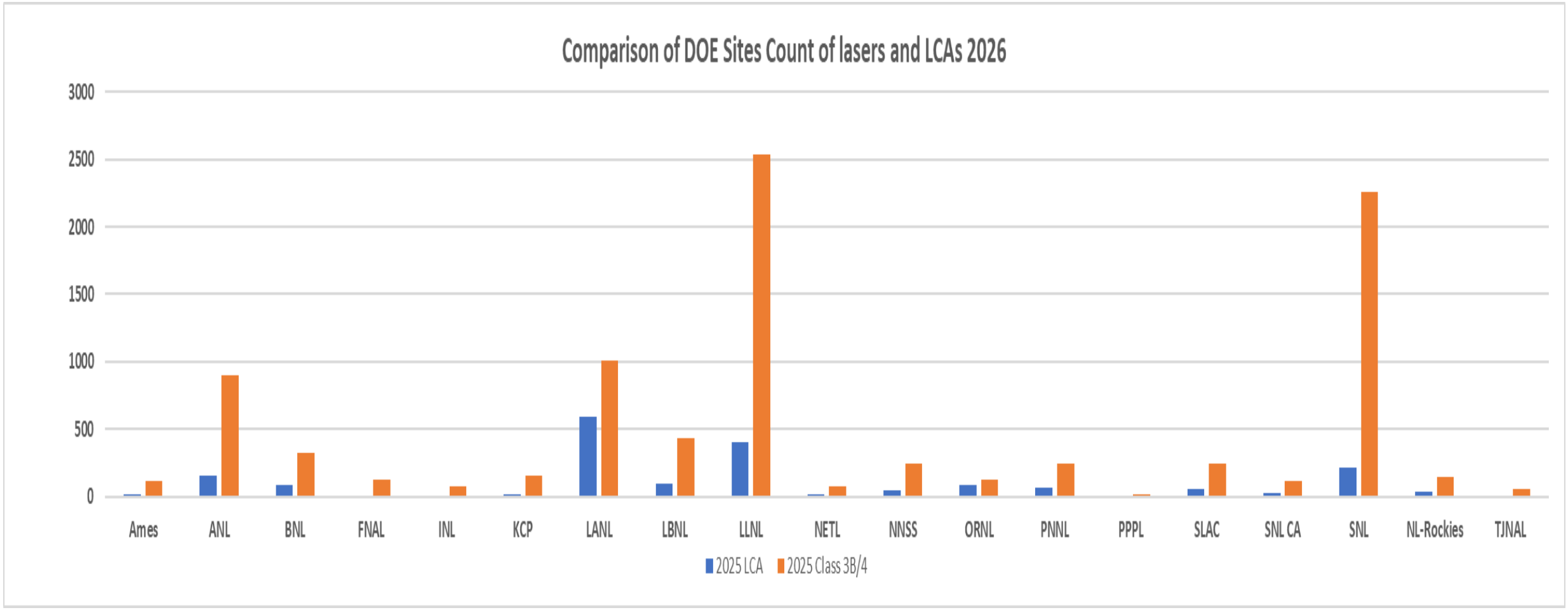
- Lab space was previously used to build HAPLS and a roll-up door was added to allow removal of the system.
- The roll-up door was controlled via an administrative lock instead of SIS.
- Facility Manager assumed laser ops were not active because the Responsible Individual was not at work.
- Door was opened for approx. 15 minutes.
- Worker who had previously been unaware of the door noticed it was open but did not hit the E-stop or de-energize lasers.

Relied upon for too long, Administrative Controls will fail at some point in their use, ALWAYS!

Miscellaneous Items

- Laser Pointers
  - Laser Pointer labeled as Class 3R but are actually at Class 3B and Class 4 levels.
  - Are there any legitimate pointers being sold out there???
- Visual fault locators
  - Improperly labeled found at more than one Site.
- Eyewear
  - Vendor arrives with no laser eyewear or found wearing no eyewear during the job or eyewear found inadequate or NOT usable.
  - Incorrect eyewear found in use or in laser-controlled area
- Laser Cutters/Engravers
  - Enclosure panels found to not be interlocked or “light” tight.
  - Non-certified and unauthorized laser engravers found in operation.

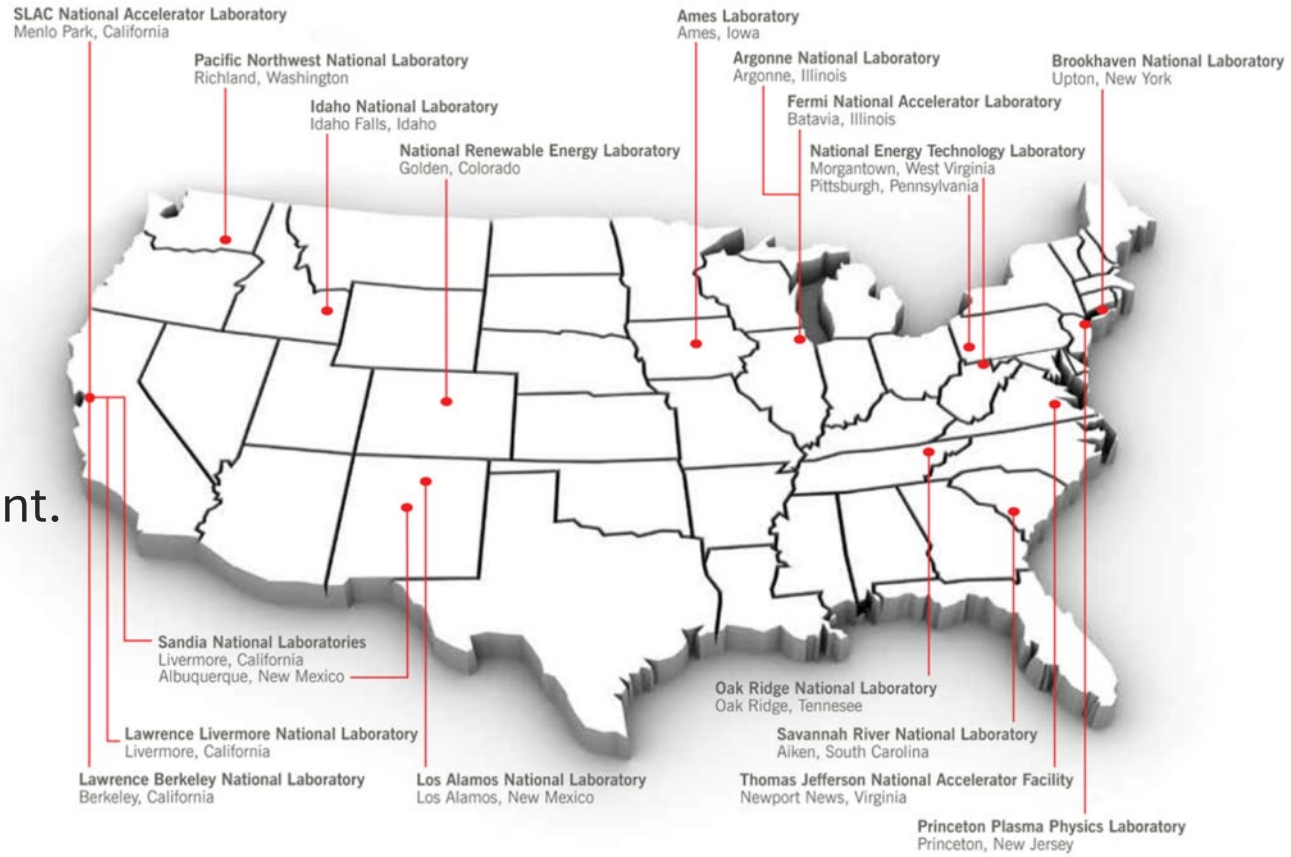
LCA's and Class 3B/4 Lasers Across DOE



~10,000 High Powered Lasers in use across the DOE Complex

State of Laser Safety across the DOE Complex

- Currently:
  - ~2,000 Laser Controlled Areas.
  - ~10,000 High Powered (Class 3B/4) Lasers.
- Since last Workshop in 2024:
  - 15 Off-Normal Events
- Majority of all laser work is in R&D environment.
- Lots of near misses and off-normal events.
  - Work to be done.
- Compared to amount of laser work, small number of events.



Near misses are the result of not paying attention to details. Accidents are the result of not paying attention to Near Misses.
PAY ATTENTION TO THE DETAILS!

Questions?