

Laser Safety

Laboratory Manager Perspective

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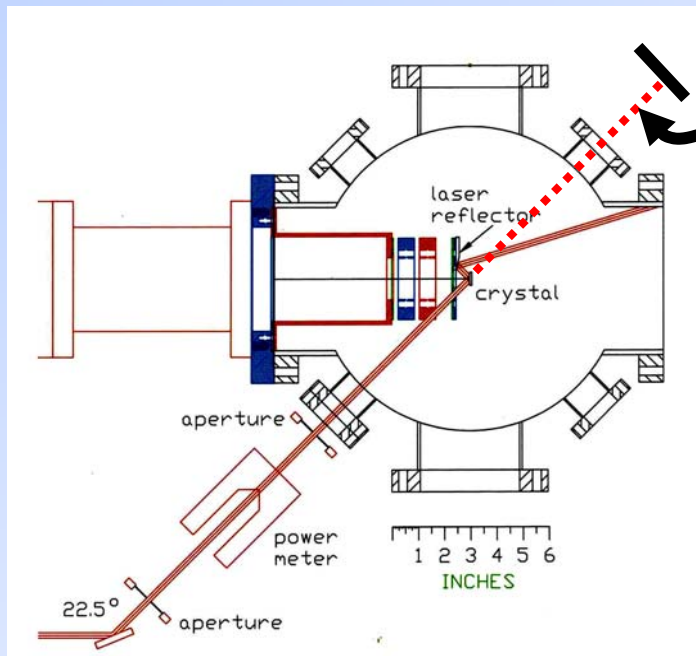
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What happened: BNL laser accident 9/9/2003

- A student was injured in the BNL Chemistry Department.
 - Stony Brook U. Ph.D. student - thesis research in surface chemistry.
 - Class IV, near-IR Alexandrite laser: 750nm, 500 mw, 20 Hz, 40 ns pulses.
 - Student and postdoc were aligning the laser into a UHV chamber
- Student had retinal burns in both eyes.
 - Student had impaired vision – difficulty reading and instructed not to drive
 - Student missed ~1 month of work.
 - Currently stable but monitored.
 - Partial (20/40) recovery of vision in one eye; full (20/20) recovery in other
 - Student continues thesis work
- BNL immediate actions
 - 9/10/2003 – Lab stand down of all laser activities, lab wide meeting
 - Chemistry Department Chair called for Type B like investigation
- Investigations: root cause
 - Direct – Personnel error, procedure not used or used incorrectly
 - Indirect – Management problem, inadequate administrative control

Accident Details

- Student and postdoc were unsure of alignment procedure.
 - Helped install the laser, but limited experience with the experiment.
 - Had observed the PI, but had not mastered procedure.
- When they did not find the PI, proceeded with an unsafe alignment.



Student observed sample with a hand mirror while postdoc aligned beam from other side.

Laser beam missed crystal and reflected off of the hand mirror into student's eyes.

Student did not wear goggles during process.

Key BNL Laser Accident Investigation Findings

Failure to follow standard operating procedures (researcher).	Protective goggles to be worn during laser experiment alignment.
Failure to stop work when unsure of safe procedures (researchers).	Student and R.A. searched for help from the principal investigator, but proceeded with a Class IV alignment without finding him.
Standard Operating Procedure was not updated for new laser (PI, department management).	An updated SOP should emphasize the new risks with a visible Class IV laser – the temptation to use direct viewing during alignment. PI and Department need to ensure updated SOPs.
Failure of system specific training and lab standard training (PI, department management).	Student completed Laser Awareness training, but does not recall reading SOP. No record of completing Lab Standard. Understanding of alignment dangers, work authorization and stop work was inadequate.
Documentation incomplete (PI, department management, LSO)	SOP not updated for new laser, some other documentation also not up to date.

Laboratory Response

Laser research restart criteria

- Chair meeting with laser users to review responsibilities
- Specific meetings with post docs and graduate students
- Review of Experimental Safety Reviews and Laser Standard Operating Procedures
- Hazards checklist developed
- Restart approval given by Deputy Director for Science & ALD for ESH&Q on case by case basis
- Several discussions with AD/BES, BHSO Manager, ALD BES

BNL/Chemistry Investigation and DOE (Laboratory Level) Review

- Root Cause analysis
- Judgements of need

BNL Management Actions

- Responsibility review (Chair to student)
- Disciplinary action
- Follow up (from JONS) to strengthen laser safety programs

New Perspectives and Lessons Learned

Student & Post Docs

- Need special attention: at least training and responsibilities reinforcement, but more broad supervision (PI); implies culture change

Work Planning

- Need Improved SOPs
 - Well-defined
 - System Annual Reviews
 - Better Implementation
- System Specific Training
- Barrier/Enclosures; no hand held elements
- Heightened Safety Awareness (especially during alignment)

Tier 1 Program

- Need laser enhanced Tier 1 inspections

Heightened Safety Awareness

- Need to continually reinforce use of laser safety eyewear
- Need to increase awareness of, and respect for, laser hazards, threshold levels

What's Better Now

Improved Support: Provide tools to make it easier to do the 'right things'

- Standard Operating Procedures – reviewed and improved; a 'Safety Envelope' document; site specific documentation
- New System Specific Training developed
- Laser Tier 1 inspection program (6 month frequency)
- Laser Safety Officer now a full time position
- Chemistry Laser Safety Coordinator
- New Associate Laser Safety Officer will be based in department
- BNL Laser Safety Committee
 - membership includes people who routinely work with lasers

Improved (Laser Safety) Culture: The laser user community better understands its roles and responsibilities for safe conduct of laser experimental work, and increasingly accepts ownership

- Heightened concern about students, postdocs

Results: Recent DOE ISM audit of Chemistry Validated Improvements

2 strengths noted: – Laser Safety inspection protocol – Laser Safety update training

What Could Make it Better Still?

Possible Enhancements in Program

- Training Tools
 - Possible 'Non-Hazardous' Optical Obstacle Course for training novice users in methodology for safe work with lasers
 - Uniform 'Core' curriculum for DOE-SC labs to make expectations and key practices comparable across the complex. Would help with 'portable' users, especially students and postdocs.
- Identify Laser User communities within SC labs and provide a 'community focus' for safety issues.
 - Possibly host local technical meeting or invite vendors to small meeting at laboratory as motivator.
 - Use meeting to build up local network among users who may be unaware of each other or the similarity of their activities and challenges
- DOE sponsored meeting of SC laboratory Laser Safety Officers & Users
 - Share expertise and 'Best Practices'
 - Interactive forum for communicating experience and lessons learned