LASER

SAFETY PROGRAM GUIDE

CALIFORNIA STATE UNIVERSITY FULLERTON
ENVIRONMENTAL HEALTH
AND SAFETY

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Laser Safety Program

I. Laser Safety Policy Statement

California State University, Fullerton's (CSUF) Laser Safety Program is intended to provide staff, researchers, students, contractors, and visitors that work with lasers, a safe working environment. All CSUF personnel, including visitors, who actively use lasers in labs, workshops, or in any other CSUF facility are required to comply with any and all requirements listed within this document as well as complete any mandatory training(s) prior to laser use. The program is intended to provide a policy and guidance on maintaining and documenting the program. This program also serves as a guidance document for laser users.

II. Authority

Regulation of laser hazards fall under the California Code of Regulations (CCR), Title 8, Subchapter 7 General Industry Safety Orders, Section 3203 (Injury and Illness Prevention Program). Section 3203 requires that every employer "...include a system for ensuring that employees comply with safe and healthy work practices...". Enforcement of the regulations falls to the California Occupational Safety and Health Administration (CAL/OSHA). At this time, CAL/OSHA has not developed specific laser safety regulations, but they train their inspectors in the ANSI Z136.1 Standard for the Safe Use of Lasers as the accepted "...safe and healthy work practice..." to use in inspecting laser facilities.

III. Scope

The CSUF Laser Safety Program primarily addresses employees but includes and is not limited to students, contractors, and visitors working directly with Class 3B and/or Class 4 lasers. These lasers are operated under Laser Use Authorizations (LUA's) that describe each laser, its use, hazard class, and the required safety measures. LUA's are maintained by contacting Environmental Health and Safety.

IV. Definitions

Accessible Emission Limit (AEL): The maximum emission level permitted within a particular laser hazard class.

Authorized Personnel: Any individual approved to work with lasers by completion of all required training(s).

Beam: A collection of rays which may be parallel, divergent, or convergent.

Continuous Wave: A laser beam with an output greater than 0.25 seconds.

Diffuse Reflection: The reflection of a laser beam in a multitude of directions by a surface.

Divergence: The splitting of a laser beam so that the diameter increases with distance traveled.

Embedded Laser: A laser of a specific class that is reduced to a lower class due to the engineering controls. Usually it is a laser that exceeds its Maximum Permissible Exposure (MPE) but is classified as a Class 1 or Class 2 because the enclosure prevents humans from coming into contact with the beam.

Fail-Safe Lock: An engineering control where the failure of a single component of the interlock will force the laser to remain in a safe mode.

Intra-beam Viewing: The act of viewing all or part of the laser beam with an exposed eye.

Laser: A laser is a device that emits light (electromagnetic radiation) through a process called stimulated emission. The term 'laser' is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers are categorized according to their hazards. Hazard classifications can be found in **Appendix A**.

Laser Control Area: A laser use area where there are engineering controls to protect the occupants within the immediate area from exposure. Laser controlled areas could be defined by walls, barriers, curtains, or by other means.

Laser Incident: Any incident involving lasers that caused harm to persons or property, or had the potential to do so.

Laser Use Authorization (LUA): The LUA is used to assure that the laser use has been evaluated and found to be safe. The LUA is also used to track the location and ownership of each CSUF laser.

Maximum Permissible Exposure (MPE): The MPE is the level of laser exposure to which the eye or the skin, may be exposed without adverse effects.

Nominal Hazard Zone (NHZ): Is the space within which the level of direct, reflected, or scattered radiation operations exceeds the applicable MPE.

Principal Investigator (PI): The PI is the campus employee directly using the laser(s).

Protective Housing: An enclosure that surrounds the laser or laser system and prevents access to laser radiation above the applicable MPE. The protective housing limits access to other associated radiant energy emissions and to electrical hazards associated with components and terminals, and may enclose associated optics and a work station.

Pulsed Laser: A laser which delivers energy in the form of a single pulse or a train of pulses. In this standard, the duration of a pulse is less than 0.25 seconds.

Q-Switch: Is a technique by which a laser can be made to produce a pulsed output beam. The technique allows the production of light pulses with extremely high (gigawatt) peak power, much higher than would be produced by the same laser if it were operating in a continuous wave (constant output) mode.

Q–Switch Laser: A laser that emits short (~10-250$_{ns}$), high-power pulses by means of a Q-Switch.

V. Responsibilities

1. EH&S Personnel:

CSUF's Environmental Health and Safety (EHS) department is responsible for the following:

- Establishing University policies and procedures for the use of ionizing and non-ionizing radiation (lasers) in accordance with CCR, Title 8 and Title 17 for Radiation;
- Maintaining documentation of initial training and refresher training;
- Arrange laser user's eye examination and maintain documentation;
- Providing personnel and other resources to assist the LSO.

2. Laser Safety Officer (LSO):

CSUF's Laser Safety Officer is responsible for the following:

- Develop and implement the Laser Safety Program and ensure campus-wide compliance; Assist with laser hazard evaluation and classification;
- Classify all constructed or modified laser systems;
- Determine required safety practices and control measures;
- Maintain an accurate campus wide laser inventory;
- Advise the faculty, staff, students, and/or any authorized person(s) regarding laser safety and regulatory affairs;
- Inform the Director and/or Associate Director of any safety concerns associated with the use of lasers;
- Approve or reject Laser Use Authorization (LUA) forms;
- Investigate all laser incidents and maintain all records associated with the Laser Safety Program;
- Conduct periodic reviews of CSUF's Laser Safety Program.

3. Principal Investigators:

Principal Investigators are responsible for the following:

- Directly responsible for implementing the Laser Safety Program;
- Notify the LSO about the acquisition, modification, sale, transfer, or disposal of lasers;
- Identify all laser hazards and implement all appropriate hazard controls;
- Maintain a written copy of this program in the workplace;
- Complete a Standard Operating Procedure (SOP) for each Class 3B and/or Class 4 laser and their location(s). SOPs shall be kept in a location so that personnel have access before entry into a Laser Controlled Area (LCA);
- Ensure all laser users operating under his/her LUA have met the appropriate training requirements and have read and understood the SOPs for specific laser(s)/laser system(s);
- Complete Injury Report Form (in the event of an accident/incident);
- Revise LUA annually.

4. Laser Users:

Laser Users are responsible for the following:

- Comply with the Laser Safety Program and use good safety practices;
- Must meet the laser safety training requirements within 30 days of joining the LUA (first time using laser);
- Know all hazards and associated procedures for the safe use of lasers in the work area by reviewing SOPs;
- Complete all required trainings as specified by a supervisor/PI, LSO, or EHS;
- Use all personal protective equipment as specified in prescribed training or required by a supervisor/PI, LSO, or EHS;
- Notify the PI and LSO of any accidents and/or incidents.

5. Department Chairs:

Department chairs are responsible for the following:

- Ensure the Principal Investigators using lasers operate those lasers safely and enforce the Laser Safety Program.

VI. Program

1. **Acquisition, Modification, Sale, Transfer, or Disposal of Lasers:**
   It is the responsibility of the Principal Investigator (PI) to document and report the acquisition, modification, sale, transfer, or disposal of Class 3B and/or Class 4 laser systems to the LSO. The PI may choose to delegate this task, but the ultimate responsibility for reporting remains with the PI. The campus purchasing department must supply the LSO with copies of laser purchase order documents.

2. **The Laser Use Authorization (LUA):**

   A. The LUA is initiated by the PI completing a LUA form (see Appendix C).

   B. The completed form is sent to the LSO who contacts the PI to discuss the laser system and application.

   C. After the LSO has evaluated the LUA, a copy is sent to the PI.

   D. In general, LUAs are reviewed by the LSO once per year.

   E. Modification of a LUA is usually done at the request of the PI. Under special circumstances, the LSO, EHS Associate Director, or EHS Director may modify a LUA.

   F. Termination of a LUA is usually done at the request of the PI. Under special circumstances, the LSO, EHS Associate Director, or EHS Director may choose to terminate a LUA.

   G. The LUA must be revised by the PI annually.

3. Laser Safety Training:

All PIs, supervisors, and laser users must successfully complete the online Laser Safety Training course. EHS is responsible for maintaining documentation of initial training and refresher training. **Laser Safety Refresher Training is required biennially.** EHS may request the PI provide supplementary laser safety training for his/her laser users. The PI must also provide and document that users operating under his/her LUA have received specific hands-on instruction in use of the laser system, safety precautions associated with the laser system, any Standard Operating Procedure's (SOPs) relating to the laser, and proper use of laser protective eye wear. Additional training may be required of laser users if a near miss occurs, competencies are not met, or if a circumstance requires it.

All first time laser users must:

A. Review the campus Laser Safety Program (LSP).

B. Read the specific LUA that pertains to them.

C. Complete the online Laser Safety Training course.

D. Complete the online examination with a passing score.

4. Laser Safety Inspections:

A. All laser facilities are inspected annually by the LSO or designee to assure that the lasers are being operated in a safe manner.

B. Copies of the inspection reports are provided to the PI for review. The LSO maintains records of all inspections performed. The PI is responsible to correct unsafe conditions in a timely manner.

C. The LSO or designee will re-inspect the laser facility within 30 days from the initial inspection to verify the corrections of unsafe conditions and compliance with the LSP.

D. If a PI is unable to correct unsafe conditions in a timely manner, the department chair will be notified.

5. Medical Monitoring Program:

CSUF requires eye exams for all Class 3B and Class 4 laser users within 60 days of first joining the LUA. Additional eye exams will be mandatory after any suspected eye injury. EHS will arrange for the laser user's eye examination. In the event the laser user wishes to use their own doctor, please provide exam results to EHS. EHS is responsible for maintaining records of exams conducted. Laser eye exams include the following:

A. Basic eye examination for glasses

B. Baseline photography

C. Optical coherence tomography

6. Personal Protective Equipment (PPE):

Appropriate PPE must be worn by operators and personnel at risk of beam exposure. The PI shall provide his/her laser users with appropriate protective eye wear; it is critical that the eye wear be appropriate to the laser class and provides sufficient protection from the wavelengths associated with the laser or laser system (refer to **Appendix B** for eyewear selection). Protective eyewear must be worn for beam alignments if the viewed beam exceeds the ANSI Z136.1 MPE (maximum permissible exposure). All PPE must be inspected before use for conditions that would reduce or negate the effectiveness of the protective equipment. **Intra-beam viewing is not allowed on the CSUF campus.** Exemptions from these policies may only be granted via the LSO.

Some ultraviolet (UV) laser users may require the use of skin protection. Any need for skin protection shall be noted in the laser system's SOP and communicated to all laser users.

7. Beam Management:

Laser beams must be restricted to the immediate location of use. Beams should be enclosed whenever practical. Beam blocks must be used to terminate beams. The use of shutters, collimators, curtains, and other beam control devices are strongly encouraged. It is the responsibility of the PI to verify through survey the appropriate beam management is being practiced. Due to the increased risk associated with this process, laser users performing beam alignment/trajectory must comply with the following:

A. Reduction of speculative surfaces;

B. Removal of all jewelry;

C. Placing the laser in alignment mode (when available);

D. Operating the laser at the lowest achievable power during alignment to reduce risk;

E. Wearing appropriate PPE;

F. Incorporation of interlock switches, beam stops, protective barricades;

G. Restricted access to the laser location to authorized personnel only.

8. Posting and Labeling:

At a minimum, all entryways into Laser Controlled Areas must be posted with a warning sign to identify the class of laser, laser power, required PPE, and laser wavelength(s). Laser enclosures must also be labeled and be properly worded, according to ANSI standards, to alert users to the laser hazards. Laser hazard signs and advice on their use are available from EHS.

9. Access Control:

Whenever the laser is in operation, access to laser facilities is restricted to authorized personnel (laser users/persons being escorted by laser users). Access control must be maintained by positive means such as locked or interlocked doors. Laser warning signs alone are not considered sufficient to control access.

10. Laser Incidents:

In the event of an accident or suspected incident involving a Class 3B or Class 4 laser or laser system, the user must notify the PI and LSO immediately. Following the incident, the PI is responsible for filing an Injury Report Form with Risk Management. The LSO is responsible for investigating laser incidents, providing a report to the PI and Risk Management. Records must be maintained on all incidents.

11. Visitors to Laser Labs:

All visitors and short term researchers must be escorted by a person whose name appears on the LUA. Short term researchers working alone must be added to the LUA.

Responsible Executive: Vice President for Administration and Finance
Responsible Office: Environmental Health and Safety
Originally Issued:
Revised: 12/2009, 9/2011, 11/2019

Appendix A

Laser Hazard Classification

The hazard class of the laser is extremely important in determining the appropriate hazard controls to make the laser system safe. The campus LSO assures that all CSUF lasers are properly designated as to their appropriate hazard class. All commercially manufactured lasers come marked with the hazard class as required under the FDA Center for Devices and Radiological Health (CDRH) regulations. Lasers made or modified at CSUF will need to be evaluated by the LSO and appropriately classed. It is the responsibility of the PI to assist the LSO by supplying the appropriate radiometric parameters of the laser system. The LSO uses the ANSI Z136.1 standard to determine the appropriate hazard class.

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Class 1 and 1M (Eye Safe Lasers)

Class 1 lasers are lasers that are safe to view with the naked-eye under all reasonably anticipated conditions of use. Very few lasers are Class 1, however many laser systems can be made into Class 1 systems by totally enclosing the laser beam and interlocking the enclosure. Class 1M lasers are safe for direct viewing, but may be hazardous when aided by optical instruments (Binoculars/Magnifying Glass). **Class 1 and 1M lasers do not require a LUA.**

Class 2 and 2M (Safe Through the Aversion Response)

Class 2 lasers emit radiation within the visible portion of the electromagnetic spectrum (400–700nm) range. Class 2 lasers will not cause injury to the eye when viewed for 0.25 seconds or less. The human aversion response (blinking or turning away from the beam) is triggered by the bright glare of the visible beam entering the eye, and is estimated to occur in about 0.25 second. Thus, eye protection is usually afforded by the aversion response.

Class 2M lasers emit visible radiation and are considered safe for accidental viewing with the naked-eye, as long as the aversion response is not overcome. However, Class 2M lasers may still pose as a hazard when viewed with the aid of optical instruments. Eye injury can occur if collecting optics are used in viewing the beam or if an individual overrides the aversion response and continues to stare into the beam path. As with all lasers, DO NOT LOOK INTO THE BEAM. Class 2 lasers may not exceed an output power of 1 mW. **Class 2 and 2M lasers do not require a LUA.**

Class 3R and 3B (Intra-beam/Specular Reflection Hazard) Reflection Hazard)

Class 3 lasers (medium power) are defined as lasers that may cause injury through intra-beam viewing or through viewing a specular reflection for less than 0.25 second. Viewing a diffuse reflection from a Class 3 laser should not be hazardous. Class 3R lasers are defined as: a continuous wave laser, which may produce up to five times the emission limit for Class 1, or Class 2 lasers. A Class 3R laser cannot produce more than 5mW in the visible region and is potentially hazardous under direct and/or specular reflection viewing conditions. Class 3B lasers exceed the output power of Class 3R lasers but cannot exceed the upper power limit of 500 mW. Direct viewing of a Class 3B laser beam can potentially cause serious eye damage. **Only Class 3B lasers require LUAs.**

Class 4 (Diffuse Reflection and Fire Hazard)

Class 4 lasers (high power) are the highest class of laser radiation and possess the same hazards as Class 3 lasers but, because of their increased beam power (greater than 500 mW), they may also cause injury to the eye when viewing a diffuse reflection. They may present a hazard to the skin, they may also present a fire hazard, and may produce laser generated air contaminants. A Class 4 Laser beam may be invisible or visible. **All Class 4 lasers require LUAs.**

Hazard Class and the Laser Use Registration

The laser's hazard class determines the need for a LUA. Only Class 3B and Class 4 lasers are required to have an LUA. The required hazard controls are a function of the hazard class and laser use.

Appendix B

Selection of Laser Safety Eyewear

American National Standard Z136.1

Table 4a

Time Factor Recommendations for CW and Repetitive Pulse Laser Optical Density Calculations*

Light Type	Wavelength Range	Diffuse (seconds)	Intrabeam (seconds)
UV	200 – 400 nm	30,000	30,000
Visible	400 – 700 nm	600	0.25**
Near Infrared (NIR)	700 – 1400 nm	600	10
Far Infrared (FIR)	1400 nm – 1 mm	10	10

* For single pulse lasers (PRF < 1 Hz) use actual laser pulse time

** For unintended or accidental viewing only. For other conditions, use the time of *intended* viewing

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PRINT

Laser Use Authorization

Appendix C

LUA No. *(EHS Only)*: _____

Part I – Laser Registration

NOTE: All lasers of Class 3B and Class 4 must be registered with the Environmental Health and Safety Office and Radiation Safety Committee (RSC).

- Please complete this form for each Class 3B or 4 laser you plan to acquire (or already have) and email to safety@fullerton.edu.
- An email confirmation will be sent to the applicant within seven days of receipt of Part I and Part II of this LUA application.
- RSC approval is required before putting laser into operation. Allow up to 30 days from receipt of completed LUA application, Part I and Part II.

Section A: Laser Holder and General Information					
Principal Investigator:					
Office Phone No:		E-mail address:			
Laser Operator(s): (Check all that apply)	☐ Paid Staff/Faculty	☐ Enrolled students	☐ Volunteer Employees	☐ Visitors	
Laser Manufacturer:		☐ CSUF Fabricated Laser			
Model Number:		Serial Number:		CSUF Property #	
Type of Laser Equipment:					
Type of Registration	☐ New Laser/laser system acquisition or installation ☐ Alteration/transfer/status change of an existing laser system* (Explain in *Comments* section below.)				

Section B: Location and Laser Details					
Department:		Building:		Room Number:	
Laser Classification (Check One):	☐ **Class 3B** (5-500 mW) or (≤ 125 mJ pulsed)	☐ **Class 4** (>500 mW) or (> 125 mJ pulsed)			
Active Medium (i.e., Argon, Ruby, Nd:YAG, Diode):					
Tunable Laser? (Check One)	☐ Yes ☐ No	*Details*			
Wavelength(s) (nanometers):					
Beam Divergence	**mrad**				
Beam Diameter at laser output:	**mm**				
Purpose and Frequency of Use: ☐ ☐ Research ☐ Classroom					
☐ Continuous Wave	Average Power (W):		Maximum Power (W)		
☐ Repetitively Pulsed	Energy per Pulse (J)		Pulse repetition frequency (Hz)		
☐ Single Pulse	Pulse duration (nsec)		Pulse width (s)		
☐ Q-Switched	Peak Pulse Power (W)		Peak Power Density (W/cm^2)		

Please check all items that apply to your operation:

☐ Invisible Beam (IR or ☐☐)	☐ High Voltage (660V)	☐ Multi-Use Room	☐ Public Theater
☐ Exposed Beam Path	☐ Beam Focusing Optics	☐ Outdoor Use	☐ Creative Arts
☐ CSUF Modified Laser	☐ Frequency-doubling Crystal	☐ Laser Cutting/Welding	☐ 3-D Printer

Comments

Laser Use Status ☐ Ready to Use ☐ In Storage (useable, stored) ☐ Needs Repair (not useable)

PI Signature: _____ Date: _____

By manually signing this form or printing my name electronically, I acknowledge that all statements are true and accurate. I certify the laser(s) will be used as described in this application and that all applicable provisions of the State of California Code of Regulations pertaining to the use of lasers and all CSUF policies, guidelines, and standard operating procedures and specific approval conditions required by the RSC now or hereafter in effect will be observed.

*Alterations include any changes(s) that substantially increases or decreases the output or wavelengths produced. Relocation from one work space to another or transfer to a new owner is also an "alteration".

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Laser Use Authorization

Section C: All personnel authorized to use lasers and/or laser systems under this LUA must be listed below:			
Last	**First**	**Email Address**	**CWID No.**

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Laser Use Authorization

Part II – Laser Use Details-Required for LUA

FOR LASERS MOTHBALLED AND NOT USED:

1. This laser is in storage and not in use._____***Initials***
2. I understand that I will notify the LSO if there is any change, such as prepare it for use or if I dismantle/discard or sell/transfer it.
3. If I decide to put this laser/laser system into use, I will fill out Part II of the LUA application and submit it to the LSO.

A. Diagram of laser or laser system set up.
Show location of beam stops, interlocks, shielding, mirrors and other relevant details or attach drawing.

B. Administrative

Please attach written safety operating procedures (SOPs) for such tasks as **Alignments**, **Emergency Shutdown**, **Powering-up, and Laser Eyewear Use** with this LUA application.

By my signature, I acknowledge that I may not begin using the laser until my Laser Use Authorization has been approved by the Radiation Safety Committee.

Laser Use Authorization Holder Signature	**Date**	**RSC Chair Signature**	**Date**
		LSO Signature	**Date**

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C. Security and Access Control

GOAL: Preventing unauthorized people from entering the laser control area

1. How will you prevent unauthorized users from entering the control area? How will you protect visitors, custodians or other "civilians" when the laser is operating? *Examples: Locks on doors, warning lights, signs, training.*

GOAL: Preventing the laser beam from leaving the optics table or controlled area

2. Describe your interlocks or other engineering controls. *Examples: Interlocked doors or gates, use of beam stops or dumps, barriers, and shields (opaque and fire resistant).* If none, explain your alternative methods.

GOAL: Preventing unauthorized access or accidental contact with the laser beam of non-laser users in the room/area.

3. Describe the engineering or management controls you will have in place to prevent room occupants contact with the laser beam. *Examples: infrared and ultraviolet sensor cards, infrared viewers, partitions, lab rules, barriers on optics table to protect users working at computers, etc.*

D. Personal Protective Equipment

1. Is eye protection required for entry or certain tasks? ☐ Yes ☐ No If **NO** eye protection will be required, please explain.

2. When will you require laser users to wear eye protection?

			Specify details (if applicable)	What wavelength(s) are you protecting against?	Duration of Exposure	Specify eyewear required
At all times when using the laser?	YES	NO				
During alignment?	YES	NO				
For entry into control area?	YES	NO				
For entry to room? (incl. visitors)	YES	NO				

3. Specify the type of protective eyewear available to laser users in this area.

	Brand	Model	Rated Wavelength	O.D.
A				
B				
C				
D				

Rated Wavelength	O.D.

Rated Wavelength	O.D.

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Appendix D: Laser Hazard Assessment

Evaluating a work operation for operational efficiency and potential safety hazards is one of the basic responsibilities of a lab manager and, in fact, is a basic component of Cal-OSHA's required Injury and Illness Prevention Program. Performing a hazard assessment to identify work hazards is essential to creating a safe work area. Before you can minimize risks, you need to know what the risks are. The chart below summarizes hazards and protective measures common to laser operations.

1. Example of a hazard assessment

Common Laser Beam Hazards	Indirect Laser Hazards	Protective measures that minimize risk of injury
Invisible beams (infrared, ultraviolet) Person leaning across a beam path Contact from escaping beams ➞ *Damaged or burned clothing* ➞ *Burned or damaged skin or eyes* ➞ *Escaping beam causing combustible materials to burn – fire hazard* ➞ *Damage to walls and equipment* **Direct or reflected viewing of beam** ➞ *flash blindness* ➞ *temporary vision loss* ➞ *damaged cornea* ➞ *burned retina*	**Reflective surfaces** ➞ Jewelry ➞ Mirrors ➞ Shiny metal objects **Toxic or pressurized chemicals** ➞ Off-gassing of dyes and chemicals ➞ Hazardous chemical exposure ➞ Compressed gases ➞ Cryogenic fluids ➞ Explosion of high pressure lamps **Electrical** ➞ High voltage ➞ Electric shocks ➞ Electrical fires	➞ Securing beam stops ➞ Shielding to contain stray beams ➞ Using low power alignment lasers ➞ Restricting access ➞ Wearing eye protection ➞ Warning signs clearly posted ➞ Mapping the beam path(s) ➞ Removing jewelry ➞ Using interlocks ➞ Training ➞ Locking out during maintenance ➞ Using lowest practical power ➞ Consistently enforcing safe practices

2. Note commonly observed unsafe practices that cause <u>preventable</u> laser accidents:

- Not wearing protective eye wear during alignment
- Misaligned optics and upwardly directed beams
- Malfunctioning equipment
- Improperly handling high voltage components of the laser system
- Lack of consideration for non-beam hazards – electric shock is the main cause of serious injury and death
- Bypassing interlocks and housing on doors and laser
- Turning on the power supply accidentally – not following required lockout procedures
- Wearing the wrong eye wear for the laser being used
- Operating unfamiliar equipment – lack of training and awareness of risks
- Intentionally exposing unprotected personnel – horseplay

3. Example of an SOP for alignment with included hazard assessment

Laser users can prevent laser-related accidents. According to a former LSO at Lawrence Berkeley National Laboratory, 60% of laser accidents in research settings occur during the alignment process.

Task: Alignment

Potential Hazards	Protective Measures	SAMPLE: Alignment Procedures
1. Beam hitting an eye 2. Beam hitting flammable or combustible materials 3. Injury to visitors 4. Beam escaping confines of the optics table	▪ Isolate the area during alignment ▪ Choose the correct eye wear ▪ Wear the provided eye wear ▪ Mark the back side of each beam stop ▪ Double-check beam stop locations ▪ Use the lowest practical power setting ▪ Take off jewelry ▪ Set beam paths below eye level of people working in the area ▪ Clearly mark any beam directed out of a horizontal plane ▪ Don't allow unauthorized or unnecessary people in the room during alignments	1. Put up a shielding curtain. 2. Make sure warning sign "***Keep Out. Alignment in progress***" is visible. 3. Put on the orange UVEX laser goggles. 4. Check beam stop locations and secure them. 5. Power up the system. 6. Take the He-Ne alignment laser and align the beam as required. 7. Identify and terminate each and every stray beam coming from any optical component moved. 8. Make sure beam paths are at a safe working height below the eye level of the user(s) before you leave.

Appendix E

GUIDELINES FOR SAFE LASER USE

Laser Beams

- Do not look directly into the primary beam or any reflection, regardless of the power.
  Always use the lowest laser or laser system classification possible.
- Always follow the applicable Standard Operating Procedure (SOP).
  Terminate the beam immediately at the end of its useful path.
- Locate the beam path at a point that is not eye level for persons standing or sitting.
- Orient the laser so that the beam is not directed toward entry points to the Laser Controlled Area (LCA).
  Minimize the possibility of specular and diffuse reflections.
- Utilize surfaces that scatter radiation and minimize specular reflection.

Laser Location

- Securely mount the laser or laser system on a stable platform.
- Clearly identify beam paths. Ensure the beam path does not cross into hallways or study, desk and traffic areas.
  Enclose as much of the laser beam as possible.
- Don't direct the beam towards doors or windows.
- Locate controls so the laser operator is not exposed to beam and non-beam hazards.

Laser Beam Alignments

- When performing beam alignments, use the lowest possible beam power and limit beam traverses.
- Utilize appropriate eye protection during beam alignment and beam instrument manipulation.
- If possible, view the beam application remotely (CCTV, etc.).
- Main beams and reflected beams must be terminated or dumped with fire resistant beam stops.

Housekeeping

- Minimize reflective objects near the beam path, on the optics bench or in the LCA.
- Be aware that cooling systems and liquid condensates can provide a specular reflective surface.
- Remove jewelry such as rings, bracelets and watches which may cause reflection.

Personal Safety

- Ensure all activation warning systems and indicator lights are working properly. Ensure laser eyewear is appropriately marked with the wavelength and optical density. Never use laser eyewear for direct viewing of the beam.
- Ensure the LSO is notified prior to servicing so that controls for a temporary LCA are specified and followed.
  Request assistance from the LPI/LSO whenever you are unsure of laser system practices.