Laser Safety Program

I. Policy

California State University, Fullerton’s (CSUF) Laser Safety Program is intended to provide those staff, researchers, students and visitors that work with lasers, a safe working environment. The program is intended to provide 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.

Copies of the standard are available from the Environmental Health and Instructional Safety Office (EHS) or on the EHS website.

III. Scope

The CSUF Laser Safety Program primarily addresses employees using Class 3a, 3b and 4 lasers. These lasers are operated under Laser Use Registrations (LURs) that describe each laser; its use, hazard class, and the required laser safety measures. A LUR file is maintained in the EHS Departmental Office, T1475.

IV. Definitions

A. 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. The hazard classifications can be found in Appendix A.

B. Laser Incident – any incident involving lasers that caused harm to persons or property, or had the potential to do so.

C. Laser Use Registration (LUR) –The LUR is used to assure that the laser use has been evaluated and found to be safe. The LUR is also used to track the location and ownership of each CSUF laser.
D. **Principal Investigator (PI)** is the campus employee directly using the lasers.

V. Accountability

A. **Laser Safety Officer**

The Laser Safety Officer (LSO) is responsible for LSP development, implementation, and compliance as well as maintaining an accurate inventory of campus lasers. The LSO will advise the faculty, staff, and students regarding laser safety and regulatory affairs. The LSO is required to inform the Environmental Compliance Manager of any safety concerns associated with the use of lasers. The LSO must investigate and approve all Laser Use Registrations (LUR). The LSO is required to classify all constructed or modified laser systems, prepare and approve all LURs, investigate laser incidents, and maintain all records associated with the Laser Safety Program. The LSO oversees the (LUR) Program. No Class 3a, 3b or 4 lasers may be used on campus without a LUR.

B. **Environmental Health and Safety**

Environmental Health and Instructional Safety (EHS) is responsible for providing personnel and other resources to assist the LSO in this program. EHS is responsible for establishing policies and procedures for the use of ionizing radiation and non-ionizing radiation (lasers) in accordance with CCR, Title 8 and Title 17 for radiation.

C. **Department Chairs**

Department Chairs are responsible for ensuring their principal investigators (PIs) using lasers operate those lasers safely and implement the Laser Safety Program.

D. **Principal Investigators**

PIs are directly responsible for implementing the LSP. This includes the implementation of specified hazard controls, oversight and management of non-laser hazards, and informing the LSO of any changes that affect the laser users. It is also the responsibility of the PI to assure that all laser users operating under his or her LUR have met the training requirements set forth by the EHS. The PI is responsible for notifying the LSO about the acquisition, modification, sale or transfer of lasers.

E. **Laser Users**

Laser users are responsible for their own safety in the laser facility. All users must meet the laser safety training requirement within 30 days of joining the LUR (using the laser). All laser users are responsible for following the LUR specific hazard controls and notification requirements.
VI. Program

A. Acquisition, Modification, Sale or Transfer of Lasers

The campus LSO must be informed of the acquisition, modification, sale, or transfer of any Class 3a, 3b or 4 lasers. The campus purchasing department supplies the LSO with copies of laser purchase order documents. It is the responsibility of the PI to inform the LSO whenever acquisition, modification, sale, or transfer of a laser or laser system occurs.

B. The Laser Use Registration (LUR)

1. The LUR is initiated by the PI completing a LUR form (see Appendix C).
2. The completed form is sent to the LSO who contacts the PI to discuss the laser system and application.
3. After the LSO has evaluated the LUR, the LUR is provided to the Environmental Compliance Manager or Director of EHS for review.
4. After review, a copy of the LUR is sent to the PI.
5. In general, LURs are reviewed by the LSO and Environmental Compliance Manager once per year
6. Modification of a LUR is usually done at the request of the PI. Under special circumstances, the LSO, Environmental Compliance Manager or EHS Director may modify a LUR
7. Termination of a LUR is usually done at the request of the PI. Under special circumstances, the Environmental Compliance Manager or EHS Director may choose to terminate a LUR

If the LSO, Environmental Compliance Manager or EHS Director if they feel the health or safety of faculty, staff or students are in immediate danger, the LUR may be suspended. The LSO or his designee maintains documentation of all changes to a LUR.

C. Laser Safety Training

EHS is responsible for maintaining documentation of initial training and Refresher Training.

All First Time Laser users must:

1. Review the campus Laser Safety Manual
2. Read their specific LUR
3. Complete the on-line Laser Safety Training course
4. Complete the on-line examination
5. Obtain course certification obtained from the web-course and send a copy to EHS
Laser Safety Refresher Training

Refresher training is required every two years. Use the same procedures as listed above.

EHS may request the PI to provide supplementary laser safety training for his/her users. The PI must also provide and document that users operating under his/her LUR have received specific hands-on instruction in use of the laser system, safety precautions associated with the laser, any standard operating procedures (SOPs) relating to the laser, and proper use of laser protective eyewear.

D. Laser Safety Inspections

1. All laser facilities are inspected annually by the LSO or designee to assure that the lasers are being operated in a safe manner.
2. 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.
3. The LSO or designee will re-inspect the laser facility within 30 days to verify the correction of unsafe conditions.
4. If a PI is unable to correct unsafe conditions in a timely manner, the department chair will be notified.

E. Medical Monitoring Program

Eye exams are required for all Class 3b and 4 laser users within 60 days of first joining the LUR. Additionally, exams will be performed 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 will maintain records of exams performed.

Laser Eye examinations include the following:

- Medical history of the User’s eye and photosensitivity
- Visual acuity (far and near) for both eyes
- Macular function (Amsler grid)
- Color vision assessment
- Dilated retinal examination of both eyes
- Retinal photographs of both eyes (while dilated)

F. Personal Protective Equipment

The PI shall provide his/her laser users with the appropriate protective eyewear (refer to Appendix B for eyewear selection). Protective eyewear must be used for beam alignments if the viewed beam exceeds the ANSI Z136.1 MPE (maximum permissible exposure) value. Intra-beam viewing of lasers is not allowed on the CSUF campus. Exemptions from these policies may be only granted by the Director of EHS.
Some ultraviolet (UV) laser uses may require the use of skin protection. Any need for skin protection will be identified by the LSO and communicated to the PI.

G. 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 that appropriate beam management is being practiced.

H. Posting and Labeling

All access points to the laser facility must be marked with the ANSI standard laser hazard signs. Laser enclosures must be labeled to alert users to laser hazards as per the ANSI standard. Labels, laser hazard signs, and advice on their use are available from EHS. Refer to Appendix F for the EHS approved ANSI laser warning sign.

I. Access Control

Whenever the laser is in operation, access to laser facilities is restricted to laser users or 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.

J. Laser Incidents

The LSO and PI must be informed immediately of any suspected laser incidents. See Appendix G for emergency procedures and emergency contacts. Following the incident, the PI is responsible for filing an Employee/Student Report of Injury form with the campus Office of 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.

K. Visitors to Laser Labs

All visitors and short term researchers must be escorted by a person whose name appears on the Laser Use Registration (LUR). Short term researcher working alone must be added to the LUR.

Appendices

Appendix A: Laser Hazard Classification
Appendix B: Selection of Laser Safety Eyewear
Appendix C: Laser Use Registration Form

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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.

Class 1 (Eye Safe Lasers)

Class 1 lasers are lasers that cannot cause injury from viewing the accessible laser radiation for the maximum possible duration inherent in the design. 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 1 lasers do not require a LUR.

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

Class 2a lasers are defined as visible lasers which are not intended to be viewed and do not exceed the Class 1 AEL (accessible emission limit) for an exposure duration less than or equal to 1000 seconds. Class 2a lasers are often used in grocery scanner systems. Class 2 lasers are defined as visible lasers that 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. 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 2a and 2 lasers do not require a LUR.
Class 3a and 3b (Intra-beam/Specular Reflection Hazard)

Class 3 lasers 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 cause injury to the eye. Class 3a lasers are defined as; an invisible laser with an output power which does not exceed 5 times the Class 1 AEL or a visible laser with an output power that does not exceed 5 mW. Class 3b lasers exceed the output power of Class 3a lasers but cannot exceed the upper power limit of 500 mW. All Class 3a and 3b lasers require LURs.

Class 4 (Diffuse Reflection and Fire Hazard)

Class 4 lasers 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 and, because of their power density; they may also present a fire hazard. All Class 4 lasers require LURs.

Hazard Class and the Laser Use Registration

The laser’s hazard class determines the need for a LUR. Only Class 3a, 3b and 4 lasers and laser systems are required to have an LUR. The required hazard controls are a function of the hazard class and laser use.

Typical Laser Hazard Classification

Hazard classes for some typical lasers are found in Appendix H of this manual. The LSO can provide information for lasers not found in the table.
### Selection of Laser Safety Eyewear

American National Standard Z136.1

Table 4a

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

<table>
<thead>
<tr>
<th>Light Type</th>
<th>Wavelength Range</th>
<th>Diffuse (seconds)</th>
<th>Intrabeam (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV</td>
<td>200 – 400 nm</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Visible</td>
<td>400 – 700 nm</td>
<td>600</td>
<td>0.25**</td>
</tr>
<tr>
<td>Near Infrared (NIR)</td>
<td>700 – 1400 nm</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>Far Infrared (FIR)</td>
<td>1400 nm – 1 mm</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

* 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