LASER SAFETY HANDBOOK FOR USE OF CLASS 3B AND CLASS 4 LASERS ON THE OSU STILLWATER AND OSU TULSA CAMPUSES

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Overview

Researchers on the Oklahoma State University (OSU) Stillwater and Tulsa campuses who use Class 3B and/or Class 4 lasers in their research or classrooms must adhere to applicable safety standards as published by American National Standards Institute (ANSI) and outlined in OSU's Institutional Laser Safety Policy, the latter of which is available on OSU's Laser Safety website.

This guide is designed to outline the responsibilities of Laser Principal Investigators (PIs) and assist in helping them design their projects and research while maintaining compliance with these safety requirements.

This manual and linked documents will be periodically updated. *It is strongly recommended that you bookmark this manual in your browser as opposed to printing it.*

Section 1: Radiation Safety Office/Officer

OSU's Laser Safety program is overseen by the Radiation Safety Office, which is located in the Office of University Research Compliance (URC) at 223 Scott Hall. URC is under the purview of the Vice President for Research. The Radiation Safety Officer (RSO) is tasked with ensuring the safety of OSU faculty, staff, and students, as well as the Stillwater community, while enabling the variety of research that involves the use of lasers on the OSU campuses.

Radiation Safety Office contact information can be found on the Radiation Safety and the Laser Safety web pages.

Section 2: Inventory

It is the PI's responsibility to ensure that his/her lasers are properly registered upon acquisition and properly removed from his/her inventory prior to transfer or disposal. Inventory verification is a part of each annual inspection, and unregistered or unaccounted for lasers will need to be addressed immediately. Registration is required for all Class 3B and Class 4 lasers, regardless of whether or not they are currently being used. PI's are responsible for all lasers on his/her inventory.

2.a: Registration

Class 3B and Class 4 lasers must be registered upon acquisition, regardless of whether or not it will be immediately used. Notify the RSO when you acquire a new Class 3B or Class 4 laser, whether purchased

new from a company or inherited from another OSU laboratory. The RSO will obtain required information from the laser and add it to the PI's inventory with a status of either "active" or "inactive."

Lasers listed as "**active**" will be listed for use on a current, approved SOP on file with the Radiation Safety Office and authorized for use in the laser laboratory.

Lasers listed as "**inactive**" will not be authorized for use until such time as they are included on a current, approved SOP that is on file with the Radiation Safety Office.

For instruments that contain embedded Class 3B or Class 4 lasers, the RSO must be notified and will determine if registration is required.

2.b: Transfer/Disposal

PIs must notify the RSO when a laser is to be removed from their inventory, whether by transfer to another PI, trade-in to a company, or via OSU's surplus department. OSU will NOT sell any working laser as there are FDA regulations, and some states have additional regulations, that put certain responsibilities on the seller. Therefore, the RSO must verify that any laser that goes to surplus is disabled prior to having it picked up by Physical Plant.

Transfer of lasers to another OSU PI or trade-in does not require disabling the laser.

Section 3: Approval/SOP

Any laser that is used on OSU Stillwater and Tulsa campuses must have a written Standard Operating Procedure (SOP) approved by the RSO and on file in the Radiation Safety Office. The SOP will approve the laser system, which includes the laser itself as well as all physical objects along the intended beam path. A copy of this approved SOP should be readily available in the laser lab so that users may reference it if needed.

The SOP should include the following information and address the topics listed below.

- Serial number, wavelength, and power of laser(s) for which the SOP is written;
- Personnel safety (see Section 4 for more information on this topic);
- Specific hazards associated with the particular laser and laser setup, including but not limited to the following topics where applicable:
    - Open beam areas,
    - Reflection hazards:
        - Specular,
        - Diffuse;

    - Laser generated airborne contaminants (see section 4.e),
    - Non-beam hazards (see section 4.f);
- Step-by-step start-up and shut-down procedures:
    - Standard,
    - Emergency;
- Signatures of those authorized to operate the laser should be on the copy of the SOP that is kept in the laboratory (see Section 5.b below).

The SOP will approve the use of a specific laser (or in some cases, multiple lasers) in the setup described within the SOP. If at any time a laser will be used in a different setup, a new SOP must be submitted and approved. Contact the Radiation Safety Officer if you have questions.

Due to the number, temporary assignment, and nature of training given to medical laser users at Boren Veterinary Medical Teaching Hospital (BVMTH), the Radiation Safety Officer may work with the BVMTH laser PI to determine a more efficient and effective means of satisfying the above listed requirements.

Section 4: Personnel Safety

The primary objective for any laser laboratory should be the safety of laser and non-laser personnel. Students, faculty, and staff who operate lasers should have a general understanding of laser safety, but they also need to know what steps they should take to avoid potential hazards presented by the specific laser system(s) with which they will work. These steps should be outlined in the SOP for each approved laser system.

The most important aspect of personnel safety is proper training. See Section 5 below for training requirements.

4.a: Basic Laser Setup

Because most research laser systems on the OSU campuses are unique and designed for specific purposes, the setup of laser systems varies greatly. Laser systems are either fully enclosed, or they have areas of open beam.

Laser systems that are fully enclosed by the manufacturer will require less information regarding setup and beam path, but information regarding interlocks, and whether or not such interlocks may be overridden, will need to be included in the SOP.

For laser systems that you will build an enclosure around to entirely encase the laser beam, this design should be explained in the SOP and include composition of enclosure and the ability of the material to

contain the laser beam. The SOP should explain that openings in these enclosures should be verified to be closed prior to powering up the laser.

For laser systems that will not be fully enclosed, PIs will need to indicate in the SOP what safety measures will be taken to reduce the risk of personnel exposure. These may include, but are not limited to:

Laser beams should never be at eye level;

- Open beam areas should be clearly marked so that all lab personnel are made aware of these locations;
- Jewelry and other reflective material should not be worn near the laser system;
- Beam stops should be around the edges of the laser table if applicable;
- Appropriate laser attenuating curtains should be installed and surround laser work area if applicable.

4.b: Personal Protective Equipment

For laser systems and setups that require eye protection, PI's are responsible for providing proper protective eyewear for all operators as well as individuals who might be in the area when the laser is being used. Protective eyewear must adhere to the following parameters:

- Only eyewear that is approved for laser protection must be used. All approved eyewear will have the range(s) of wavelengths they will attenuate, as well as the optical density (OD) for each indicated range.
- The wavelength of the laser being used **must** be included in the range of wavelengths listed on the eyewear.
- The OD of the eyewear for the range of wavelengths you are attenuating must be adequate for the laser setup you are using. Contact RSO if you have questions about this.
- Eyewear must be in good condition and properly stored, i.e. free of scratches on lenses and straps/earpieces in good working condition.

ALL individuals present in the nominal hazard zone (see section 7.b) must be wearing the prescribed eye protection.

4.c: Laser On Notification

There are two signage requirements for laboratories where Class 3B and/or Class 4 lasers and laser systems will be used. First, all entrances to these laboratories must have signage on the doors that indicate the class and wavelength of the laser(s) present. These signs must meet specific design parameters and will be provided by the Radiation Safety Office.

The second signage requirement is an illuminated sign that indicates the laser(s) inside of the laboratory is powered on. These illuminated “laser on” or “laser in use” signs should be outside of the laboratory at each entry point. Design parameters are somewhat flexible on these signs, but each sign must be approved by the Radiation Safety Office. Illuminated signs should be positioned so that they are easily noticeable to all who might enter the laboratory. PIs are responsible for the purchase and installation of these signs.

SOPs should include that illuminated signs should be turned on prior to powering up the laser inside of the laboratory. All laser users should be trained to do so, as well as to turn off the sign when the laser is powered down.

Non-laser personnel who might enter the lab space should be trained to knock or get permission to enter the laboratory in some other way prior to entering a lab when the illuminated sign is on.

4.d: Laser Generated Airborne Contaminants

Interaction between the beam and the target material will result in a cloud or plume of contaminants. These are referred to as laser generated airborne contaminants, or LGACs. The nature and chemical composition of LGACs will vary with the type(s) of target material used. The PI must take into consideration what kinds of LGACs may be produced and determine if precautions are needed to prevent exposure of harmful LGACs to users. Such precautions may be special exhaust systems, personal respiratory protection, or cloud containment.

4.e: Non-Beam Hazards

Users should be made aware of potentially hazardous aspects of the laser system outside of the beam. These could include, but are not limited to, the following:

- Electrical hazards,
- Chemical hazards (e.g. dyes, gases, LGACs),
- Compressed gas hazards,
- Cryogenic hazards,
- Fire hazards,
- Collateral radiation.

Section 5: Training for Users

All users of Class 3B and/or Class 4 lasers on the OSU Stillwater and Tulsa campuses must be adequately trained prior to operating these lasers.

5.a: Online Training

All laser users, both PIs and those on their permits, are required to take the online training provided by the Radiation Safety Office. Laser Safety Training Request forms are available on the Laser Safety website and should be submitted to the Radiation Safety Officer via campus mail or e-mail.

There are two types of training provided by the Radiation Safety Office:

- The Laser Safety Training Course is required of all non-medical laser users. This training consists of a series of slides, a video, and a subsequent test.
- The Medical Laser Safety Training Course is required of all medical laser users. On the OSU Stillwater and Tulsa campuses, these users are limited to those who will use the medical lasers at Boren Veterinary Medicine Teaching Hospital. This training consists of a video followed by a test.

The training provided by the Radiation Safety Office is a one-time training that provides some very basic laser information and awareness.

5.b: Laser Specific Training

Laser PIs are responsible for training their laser users on the specific hazards of the lasers in their laboratories. As laser setups in research settings can be very dynamic and change frequently, it is of utmost importance that users to be instructed and made aware of the types and locations of hazards that are intrinsic to your laser system design(s).

As this information is required in the SOP for each setup, each user must sign off on having read and understood the SOP. This will document that the user has been made aware of the hazards and understands how to safely operate your laser system. Re-training of users must be done at least every three years, but may be done more often if the PI deems it appropriate.

As PIs create their SOP(s) and are expected to know the intricacies of system design well enough to train their users, they are not required to sign off on this laser specific training.

Due to the number, temporary assignment, and nature of training given to medical laser users at Boren Veterinary Teaching Hospital (BVMTH), the Radiation Safety Officer may work with the BVMTH laser PI to determine a more efficient and effective means of satisfying the above listed requirements.

Section 6: Inspections

The Radiation Safety Officer will inspect all Class 3B and Class 4 laser laboratories and laser systems in use on the OSU Stillwater and Tulsa campuses. Initial inspections are done so that the Radiation Safety Officer can approve the use of a laser and/or a new laser PI. Annual inspections are performed by the Radiation Safety Officer to verify inventory and that lasers are being used in compliance with submitted SOPs.

6.a: Initial (New Laser) Inspections

All new lasers and laser systems must be approved by the Radiation Safety Officer before they can be used. This includes new setups for existing lasers. If a new SOP is required, then the setup must be inspected prior to use.

Initial inspections will be performed for any of the events listed below:

- A new laser PI, regardless of whether they will be registering a new laser or using an existing one;
- A current laser PI who will be registering a new laser;
- A new or current laser PI who will be using an existing laser in a new setup/configuration.

As SOPs, protective equipment, and approval of system setup will be required to be in place prior to the system being approved for use, **it is highly recommended that the Radiation Safety Officer is notified of potential new Laser PIs, new lasers being purchased, or new laser setups as soon as possible**. With adequate notification, the Radiation Safety Officer can have many aspects of the new approvals completed prior to new lasers arriving.

6.b: Annual Inspections

All approved laser PIs, lasers, and laser laboratories on campus must be inspected once per year. Inspections will verify that the following requirements are being met:

- Inventory, both active and inactive,
    - New lasers have been properly registered with the Radiation Safety Office,
    - Lasers no longer in PI's possession have been properly disposed of via the Radiation Safety Office (or transferred to another PI) and removed from PI's inventory;
- Use of lasers is consistent with that described in current SOPs;
- SOPs are readily available for reference;
- Protective equipment, as described in SOP, is present, in use, and in good condition. Protective equipment may include, but is not limited to, any of the following:

    - Eye protection,
    - Beam stops,
    - Window covers,
    - Laser curtains;
- List of users is current and complete, and no unauthorized use is permitted;
- Security of laser(s);
- Training for all users is complete and current,
    - Training certificates from Radiation Safety Office present,
    - Documentation that all users have been trained on the laser(s) they use. Training dates for this laser specific training must be within the last three years (see section 5.b for more information);
- Proper signage on door;
- Illuminated sign outside door is in working condition and being used appropriately.

Upon scheduling your annual inspection, the Radiation Safety Officer will send you copies of your current inventory, list of users, and SOPs that are on file so that you can verify they are still current. If updates are required, it is best if you can address them prior to your inspection to expedite the inspection process.

If the Radiation Safety Officer identifies items during your inspection that should be addressed, you will receive an e-mail listing the issues and what corrective actions need to be taken. Upon completion of all listed corrective actions, you will receive a signed inspection letter from the Radiation Safety Officer with the date of inspection that you will use for grant routings. A copy of this letter will be sent to your department head for departmental records. Additionally you will receive an e-mail, also copied to your department head, with inspection date to be used for grant routings.

Please note that if a laser PI does not schedule his/her annual inspection, or does not comply with corrective actions in a timely manner, the Radiation Safety Officer may choose to not sign off on any grant routings that include laser use for that PI until the requirements are met.

Section 7: Radiation Safety Office and Laser Safety Committee Responsibilities

The Radiation Safety Office is overseen by the Radiation Safety Officer, who is charged with providing guidance and support to OSU faculty, staff, and students who use lasers in their research to ensure that applicable policies and safety standards are being met. The Radiation Safety Officer will inspect laser laboratories no less than once per year. Other inspections may be scheduled as new lasers and/or new laser setups are in place.

The Radiation Safety Officer will report overall inspection findings and trends to the Laser Safety Committee, which is composed of OSU faculty who are laser PIs, a member of Administration, and the Radiation Safety Officer. This committee determines OSU laser-related policies and acts as support and a source of reference and guidance to the Radiation Safety Officer when needed.

7.a: Semi-annual reports

The Radiation Safety Officer will send out reports to Laser PIs twice per year. These reports will have the current laser inventory that is on file with the Radiation Safety Office, the approved lab locations, and the training status of all approved laser users on the PI's permit. The PI should make any changes to inventory, lab locations, and list of trainees (request to add or remove users) on the report. He/she should also make note of those users who may not have completed the online training requirement and ensure that they do so. The PI will need to sign the report, with any changes noted, and return it to the Radiation Safety Office.

These reports will allow the PI to verify that the information on file in the Radiation Safety Office is accurate and up-to-date.

7.b: Hazard Analysis

The Radiation Safety Officer will perform hazard analysis on each laser system used. When deemed necessary by the Radiation Safety Officer, calculations will be done to define a nominal hazard zone (NHZ). The Radiation Safety Officer will work with the PI to clearly mark and identify the NHZ and ensure that all laboratory personnel are aware of the safety requirements within the NHZ. This information will need to be incorporated into the SOP for that laser system.

7.c: Radiation Safety Office as a Resource for Principal Investigators

The Radiation Safety Office exists to guide researchers in performing their research involving laser use in such a way that the safety risks to laser users and non-users alike are minimized. It is the goal of the Radiation Safety Officer and the Laser Safety Committee to work ***with*** laser PIs to ensure that laser research continues while promoting safety and compliance with accepted standards and safe practices.

Questions about laser practices and procedures can be e-mailed to lasersafety@okstate.edu. Radiation Safety Officer and Laser Safety Committee contact information can be found here.