



Non-Ionizing Radiation Safety Program

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Program Approval Record

Revision: 0		
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Program Approval

<i>Signature on file in the EHS office</i>	<i>3/14/11</i>
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Non-Ionizing Radiation Safety Program

1. Purpose

This Non-Ionizing Radiation Safety Program describes policies, procedures, equipment, personal protective equipment, and work practices that are capable of:

- Ensuring that no laser radiation in excess of the MPE reaches the human eye or skin;
- Ensuring adequate protection against laser-related non-beam hazards;
- Ensuring that the hazards of other sources of hazardous levels of non-ionizing radiation are identified and that appropriate protective measures are implemented to prevent injuries and property damage; and
- Ensuring compliance with applicable regulatory requirements and established best practices.

Laser safety program requirements are based upon The American National Standards Institute (ANSI) Z136.1-2007 Standard for Safe Use of Lasers.

2. Applicability

Non-ionizing radiation is electromagnetic radiation that does not carry enough energy per quantum to ionize atoms or molecules, e.g wavelengths great than 100 nanometers. Examples of non-ionizing radiation include lasers, ultrasound, radiofrequency radiation, microwaves, infrared radiation (IR), visible light, ultraviolet radiation (UV), and magnetic radiation fields. Examples of equipment that emit non-ionizing radiation include Nuclear magnetic resonance (NMR) and UV germicidal lamps. Welding is not included in this program; rather welding is addressed by the Hot Work program.

This program applies to uses of non-ionizing radiation emitting equipment at the university, with the exception of following equipment, which is exempt from the requirements of the non-ionizing radiation program:

- Laser pointers and distance measuring devices (classes other than 3B or 4). Class 3B or 4 laser pointers must not be used at SCU without approval by the LSO.
- Microwave ovens used for food preparation or used for other purposes if similar to those sold to the general public
- Televisions, computers, cellular phones and similar equipment sold to the general public
- Building sources such as power transmission lines and electrical wiring, outlets and lighting.

3. Definitions

NOTE: The most pertinent definitions for all users are contained in Attachment 1. Review and use as necessary.

4. Roles and Responsibilities

The following are the SCU Roles and Responsibilities in regards to Non-Ionizing Radiation Safety:

Group	Responsibilities
Associate Provost for Research Initiatives	▪ Appoint the members of the Radiation Safety Committee.
Radiation Safety Committee	▪ Provide non-ionizing radiation safety policy development and oversight. ▪ Provide oversight of the non-ionizing radiation safety program. ▪ Participate in periodic reviews of the use of non-ionizing radiation at SCU.
Laser Safety Officer (LSO) (Environment, Health and Safety)	▪ Administer the day-to-day operation of the Non-Ionizing Radiation Safety Program. ▪ Maintain a current inventory of Class 3B and 4 lasers and other sources of hazardous non-ionizing radiation. ▪ Provide technical support in regard to non-ionizing radiation safety hazards, controls and procedures to the Radiation Safety Committee, Faculty, staff and others as needed. ▪ Provide ANSI approved warnings signs and labels. ▪ Manage a program for conducting periodic audits of non-ionizing radiation safety facilities, controls and procedures. ▪ Manage a program for investigating non-ionizing radiation safety related incidents. ▪ Report findings and recommendations from audits and incident investigations to the Radiation Safety Committee and, where appropriate, to the relevant academic department chair. ▪ Ensure that each laboratory with Class 3B or 4 lasers or other equipment with the potential to emit hazardous non-ionizing radiation has operational SOPs, appropriate controls and emergency plans for dealing with fires and injuries. ▪ Conduct or otherwise support laser and other non-ionizing radiation safety training. ▪ Ensure that this Non-Ionizing Radiation Safety program is kept up-to-date with regulatory requirements and applicable best practices.
Laboratory Supervisor	▪ Identify the non-ionizing safety hazards associated with proposed equipment, research or teaching exercise, the appropriate level of containment, the laboratory practices and techniques required to perform the experiments safely and emergency procedures. ▪ Submit an application for the possession and/or use of Class 3b or 4 lasers or other equipment that emits hazardous levels of non-ionizing radiation to the Radiation Safety Committee. ▪ Implement the approved level of containment, laboratory

	practices and techniques and emergency procedures. ▪ Develop and post a written SOP(s) in a location readily available to laser operators for all unenclosed Class 3B and 4 lasers, obtain LSO approval, and ensure compliance with the SOP. Develop SOP(s) for other sources of non-ionizing radiation at the direction of the LSO. ▪ Ensure that staff and students receive training in, know and follow the specific laser and other non-ionizing radiation safety laboratory practices applicable to their work. ▪ Notify the committee in writing and in advance if there any changes in equipment, laboratory practice or emergency procedures are planned. ▪ Ensure the safe and responsible disposition of their unneeded, but potentially hazardous, class 3b or 4 lasers and laser components.
Users of Lasers and other sources of hazardous non-ionizing radiation	▪ Know the hazards and the precautionary procedures for the use of lasers and other sources of hazardous non-ionizing radiation in the work area ▪ Attend required training(s) ▪ Plan and conduct operations in accordance with approved SOPs and and good safety practices/ ▪ Use personal protective equipment in accordance with prescribed training.

5. Requirements

Program Administration

The Non-Ionizing Radiation Safety program will be managed by the Santa Clara University Radiation Safety Committee and the Radiation Safety Officer in accordance with the responsibilities listed in Section 4 of this program. Unless otherwise noted, the Radiation Safety Officer (RSO) serves as the Laser Safety Officer (LSO).

Pre-Use Review and Approval Process

Lasers

Prior to purchasing, installing, or using lasers containing Class 3b or 4 lasers, the PI must complete following steps:

- Submit a completed Non-Ionizing Radiation Registration form to the LSO. This document is presented in Attachment B.
- Respond to requests for additional information or modifications.
- Receive written approval of the application.

Upon receipt of the completed application, the LSO will send the form to the Chair of the Radiation Safety Committee. They will review the application for completeness and will request modification of the form if needed. Once complete, the LSO and Chair of the Radiation Safety Committee will distribute the form to members of the Radiation Safety Committee with their recommendation. The Radiation Safety Committee will take

appropriate and timely steps to review the application by e-mail, phone, or in-person meeting and review concerns or questions with the PI.

The decision to approve or deny the application will be communicated by the LSO or the Chair of the Radiation Safety Committee by submitted a completed form to the PI.

Other Equipment that Emits Non-Ionizing Radiation

Prior to purchasing, installing, or using equipment that emits non-ionizing radiation, the responsible Laboratory Supervisor must notify the LSO in writing regarding the proposed purchase, with the exception of equipment listed as exempt in Section 2. The LSO will review the proposed equipment and determine if it could be added to the exempt list or added to the inventory of registered equipment. If equipment will be added to the inventory, the Laboratory Supervisor will complete a Non-Ionizing Radiation Registration form to the LSO. The review and approval process will be the same as that of presented above for lasers.

Modification and Transfers

A Non-Ionizing Radiation Registration form must be re-submitted when significant modifications are made to the original laser/laser system or other registered non-ionizing radiation equipment, such as moving from one lab to another, modifications impacting laser controls or transfer from one PI to another.

Disposal

The LSO must be notified when registered non-ionizing equipment is sold or disposed of. The LSO will review disposal plans, coordinate with other University programs such as equipment donation programs or the Hazardous Waste Program, as appropriate and remove from the inventory upon disposal.

Qualification

Users of registered non-ionizing radiation equipment must complete the training presented in Section 6 of this program prior to using them.

Equipment Inventory

The LSO will maintain an inventory of Class 3B and 4 lasers and other registered non-ionizing radiation equipment. Where unenclosed Class 3b and Class 4 laser beams are present, the LSO or other appropriately trained individual will also establish the Nominal Hazard Zone (NHZ) in accordance with local or country regulations and ANSI Z136.1-2007.

Control Measures Class 1- 3R Lasers

- As with any piece of equipment PIs are responsible for ensuring training on proper use of that equipment.
- Exposure to laser radiation must be kept below the Maximum Permissible exposure (MPE) under all conditions of operation or maintenance.
- Laser systems must have the appropriate warning labels with the laser sunburst logotype symbol and the appropriate cautionary statement.
- Removal of protective housing or system modification can increase a laser's classification. Contact the LSO for review prior to servicing or system modification.

- Ensure that users of Class 2 or 3R lasers:
 - Do not stand within or stare at the laser beam.
 - Do not point the laser at a person's eye at close range.
- Use of Class 2 or 3R lasers with the aid of optical instruments should be reviewed by the LSO prior to operation.

Control Measures Class 3B and 4 Lasers

Control measures are only required within the NHZ.

Class 3B Control Areas

Prior to use, implement engineering controls including:

- All area or entryway safety controls must be designed to allow rapid egress by laser personnel and admittance to the laser controlled area under emergency conditions.
- Must have all windows, doorways, open portals, etc. either covered or restricted in such a manner as to reduce the transmitted laser radiation to levels at or below the applicable ocular MPE.
- Must have only diffusely reflecting materials in or near the beam path where possible.

Prior to use, implement the following controls and integrate into written area SOPs as appropriate. The SOPs must comply with the laser manufacturer's recommendations:

- The operation of the laser must be under the supervision of an individual knowledgeable in laser safety.
- Only trained and authorized personnel are permitted to operate lasers and laser systems.
- Lasers must be labeled with appropriate Class 3 DANGER statements, and rooms must be placarded hazardous areas with appropriate danger signs.
- Proper safety eyewear must be provided and worn if there is a chance that the eyes will be exposed to the beam or a hazardous specular reflection. SOPs must prohibit aiming a laser at a person's eye.
- Ensure that as much of the beam's path is enclosed as practical.
- Avoid placement of the unprotected eye along or near the beam axis, as attempted in some alignment procedures.
- Terminate the primary and secondary beams, if possible, at the end of their useful paths.
- Assure that any spectators are not exposed to hazardous conditions.
- Make every effort, through proper design and use procedures, to keep laser beam paths above or below eye level for both sitting and standing positions.
- Mount the laser on a firm support to assure that the beam travels along the intended path.

Class 4 laser control areas

Class 4 laser control areas must incorporate all Class 3B control measures, plus the following:

- Control area interlocks or alternate controls to preclude the entry of unprotected personnel while Class 4 laser radiation is present in the control area. The interlock system may be designed to preclude entry while the laser is operating or to terminate laser operation when the door is opened without deliberate overriding of the interlock by a trained laser user.

or

- Blocking barrier, screen, curtains, etc. must be used to block, screen, or attenuate the laser radiation levels so that the MPE is not exceeded at the entry point.
- At the entryway there must be a visible or audible signal indicating that the laser is energized and operating at Class 4 levels. A lighted laser warning sign or flashing light (visible through protective eyewear) are acceptable entryway warning light alternatives.
- If the laser beam irradiance represents a serious skin or fire hazard, use a suitable shield between the laser beam and personnel.
- Use dark, absorbing, diffuse, fire resistant targets and backstops where feasible.
- Keep the work area free of reflecting surfaces such as tools.
- Follow proper electrical procedures when using the laser.

Control of Other Registered Non-Ionizing Radiation Equipment

As part of the process of registering other non-ionizing radiation equipment, the PI will identify control measures appropriate to the type of radiation. At minimum, the following must be addressed:

- Applicable exposure limits and monitoring
- Appropriate warning signs for the doors of all entrances to the room where the non-ionizing radiation equipment is used. At a minimum, signage must meet applicable regulatory standards
- Use of shielding
- Personal protective equipment, such as specialized safety glasses/goggles

At a minimum, the following requirements must be met for ultraviolet radiation:

Sterilizing lamps or other equipment producing ultra-violet radiation must be arranged or shielded to prevent UV radiation from striking employees' eyes in harmful intensity; where such arrangement or shielding is not practicable, appropriate protective goggles must be provided and worn. Areas, rooms or locations where equipment producing UV radiation is located must be posted with warning signs.

Annual Review

The Laser Safety Officer will conduct a review of the Non-Ionizing Radiation Safety program and compliance with its requirements at least annually. The results of this

review will be communicated to the Radiation Safety Committee for review and corrective action as required.

Emergencies and Exposures

The responsible Laboratory Supervisor must always be notified of beam and non-beam related incidents or other incidents involving non-ionizing radiation emitting equipment. If assistance is needed, call Campus Safety Services x4444.

Accident Investigation and Reporting

Accidents involving injury or illness must be reported on the Supervisor's Injury/Illness Report Form (available from Human Resources) and distributed as indicated.

All accidents and near misses/accidents (injuries, fires, spills, explosions) shall be reported in writing (email) to EHS (ehs-facilities@scu.edu) as soon as possible after the occurrence.

EHS will analyze accidents and "near misses" and provide recommendations to proper authorities.

6. Training

Before working with class 3B or 4 lasers, SCU faculty, staff and students are required to receive laser safety training. Required training includes the following:

- Laser Safety course designed for users of Class 3B or 4 lasers.
- Hands-on training provided by the PI regarding the specific hazards of the Class 3B or 4 lasers used in the lab, applicable controls and approved SOPs.

Training for other registered non-ionizing radiation equipment will be identified as part of the development of equipment specific SOPs by the responsible Laboratory Supervisor.

7. Reporting

The RSO will annually review the Non-Ionizing Safety program for compliance and refer any issues to the Chair of the Radiation Safety Committee. If the program is found to be non-compliant, the Radiation Safety Committee will take appropriate actions, including root cause analysis, to ensure that the issues are corrected going forward.

8. Document Retention

The following documents are retained at these locations for three years, unless otherwise indicated:

Record	Location	Duration	Responsible Party
Laser Registration form	EHS Files	Until superseded	Laser Safety Officer
Annual Laser Safety Program Review	EHS Files	3 Years	Laser Safety Officer

Incident Investigation Record	EHS Files	3 Years after termination of employment	Laser Safety Officer
Personnel Training	EHS Files	3 Years after termination of employment	Laser Safety Officer
Department SOPs	PI files	Until superseded	PI

9. Key References and Resources

- ANSI Z136.1 – American National Standards Institute Z136.1-2007 (or latest version thereof) Standard for the Safe Use of Lasers
- 8 CCR 5079 Ultra-Violet Radiation
- 8 CCR 5085 Radiofrequency and Microwave Radiation

Attachment 1 - Definitions

Maximum Permissible Exposure (MPE) is the level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin.

Nominal Hazard Zone (NHZ) is the space within which the level of direct, reflected, or scattered laser radiation during normal operation exceeds the maximum permissible exposure (MPE)

Primary Investigator or Primary Instructor (PI)- The Santa Clara employee bearing primary responsibility for all essential aspects of the work being carried out, including technical, budgetary and administrative compliance.

Registered Non-Ionizing Radiation-Emitting Equipment: All Class 3B or 4 lasers and other non-ionizing radiation-emitting equipment identified as hazardous and requiring registration by the Radiation Safety Officer.

Attachment 2 - Laser Classes

American National Standards Institute Z136.1-2007

Class 1

This class is eye-safe under all operating conditions.

Class 1M

This class is safe for viewing directly with the naked eye, but may be hazardous to view with the aid of optical instruments.

Radiation in classes 1 and 1M can be visible, invisible or both.

Class 2

These are visible lasers. This class is safe for accidental viewing under all operating conditions. However, it may not be safe for a person who deliberately stares into the laser beam for longer than 0.25 s, by overcoming their natural aversion response to the very bright light.

Class 2M

These are visible lasers. This class is safe for accidental viewing with the naked eye, as long as the natural aversion response is not overcome as with Class 2, but may be hazardous (even for accidental viewing) when viewed with the aid of optical instruments, as with class 1M.

Radiation in classes 2 and 2M is visible, but can also contain an invisible element, subject to certain conditions.

Class 3R

Radiation in this class is considered low risk, but potentially hazardous. The class limit for 3R is 5x the applicable class limit for Class 1 (for invisible radiation) or class 2 (for visible radiation).

Class 3B

Radiation in this class is very likely to be dangerous. For a continuous wave laser the maximum output into the eye must not exceed 500mW. The radiation can be a hazard to the eye or skin. However, viewing of the diffuse reflection is safe.

Class 4

This is the highest class of laser radiation. Radiation in this class is very dangerous, and viewing of the diffuse reflection may be dangerous. Class 4 laser beams are capable of setting fire to materials onto which they are projected.

Attachment 3 - Non-Ionizing Radiation Registration Form

☐ New Application ☐ Updated Application (list reason for update such as moving the equipment from PI to another and/or from one location or another)		
Principal Investigator//Licensed User	Department	Phone Number: E-mail:
Type of Non-Ionizing Radiation ☐ Laser Class 3B ☐ Laser Class 4 Type of Laser (e.g argon gas laser, Neodymium YAG) ☐ Other Non-Ionizing Radiation (specify type such as ultrasound, radiofrequency radiation, microwaves, infrared radiation (IR), visible light, ultraviolet radiation (UV), and magnetic radiation fields)		
Manufacturer and Model # (if available)	Serial Number	Year of Manufacture
Equipment Location (Building/Room number)	List rated output power or pulse energy and check the correct units ☐ mW ☐ W ☐ mJ ☐ J	List the nominal wavelength and check the correct units ☐ microns ☐ angstroms ☐ nm
Describe use of this equipment by the PI:		
Describe safety features and security measures:		

As principal investigator for research using the above source of non-ionizing radiation, I certify that I am familiar with the regulations for use and agree to abide by the Santa Clara University Policy and Procedures applicable to their use. The information in this form is accurate and complete.

_____ Signature, Principal Investigator	_____ Date
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Application Reviewed and Approved by the Laser Safety Officer (RSO)

_____ (Signature of LSO)	_____ (Date)
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Application Reviewed and Approved by RSC

_____ (Signature of Chair)	_____ (Date)
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