Chapter 10: Laser Safety

Laser Hazards, Classification, and General Requirements

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1 Purpose

The purpose of these requirements is to ensure applicable controls are in place for each class of laser.

They cover classification, project management, purchase, hazard analysis, control selection, electrical safety inspection, labeling, and use of all classes of lasers.

They apply to workers using lasers, *system laser safety officers (SLSOs)*, *laser facility program managers*, line management, and the *laser safety officer (LSO)*.

2 Laser Hazards and Classification

2.1 Laser Classification

Lasers are classified according to their hazard, based on accessible radiation during *normal operation*. A commercial laser purchased with a manufacturer-provided hazard classification that is in conformance with the Federal Laser Product Performance Standard (FLPPS, 21 CFR 1040.10 and 21 CFR 1040.11) fulfills all classification requirements.

Lasers fabricated for research and without manufacturer's assurance of FLPPS compliance must be classified prior to operation.

The LSO will classify lasers and laser systems when

- The classification is not provided,
- The classification is not in accordance with the FLPPS,
- The intended use is different from the use recommended by the manufacturer, or
- Engineering control measures are added, deleted, or modified.

Laser classes are given in Table 1.

Table 1 Laser Classes and Hazards

Class	Hazard
Class 1	▪ Emitted radiation may be visible or invisible ▪ Incapable of producing damaging radiation levels ▪ May have an accessible laser beam at very low intensity, or may be a fully enclosed laser with no accessible radiation ▪ Exempt from any administrative or PPE control measure requirements
Class 2	▪ Emits visible radiation at wavelengths between 400 to 700 nanometers (nm) ▪ Eye aversion response (blinking or looking away) provides adequate protection, but eye injury is possible if there is an intentional prolonged exposure. The eye aversion response time is assumed to be 0.25 seconds. ▪ Maximum average power for *continuous wave (cw) lasers* is 1 milliwatt (mW) ▪ Can present a startle hazard and may cause temporary flash-blindness, after images and glare responses; thus some controls are needed to prevent an accidental exposure
Class 3R (previously called 3a)	▪ Emitted radiation may be visible or invisible ▪ Visible laser radiation is greater intensity than Class 2 but must be within a factor 5 of the Class 2 accessible emission limit (maximum average power for cw lasers is 5 mW). Invisible laser radiation is greater intensity than Class 1 but must be within a factor 5 of the Class 1 accessible emission limit. ▪ Generally not considered a significant hazard for accidental viewing, but is a potential hazard for direct or *specular reflection* viewing ▪ Visible lasers can present a startle hazard and may cause temporary flash-blindness, after images and glare responses; thus, some controls are needed to prevent accidental exposure
Class 3B (previously called 3b)	▪ Emitted radiation may be visible or invisible ▪ Emitted radiation has intensity greater than Class 3R. Maximum average power is less than 500 mW (can be lower for *pulsed lasers*). ▪ Eye hazard for direct or specular reflection viewing; there are associated laser eyewear protection requirements. ▪ Potential skin hazard for exposures to ultraviolet (UV) lasers, which would require skin protection
Class 4	▪ Emitted radiation may be visible or invisible ▪ Emitted radiation has intensity greater than Class 3B ▪ Hazard to eye or skin from direct beam; there are associated laser eyewear protection requirements ▪ *Diffuse reflections* may be hazardous ▪ Potential for fire hazard from laser intensity exceeding combustibility thresholds of some materials ▪ Laser-target interactions may produce laser-generated air contaminants, and hazardous *plasma radiation* at very high intensities

2.2 Laser Exposure Effects and Symptoms

2.2.1 Startle Hazard

An eye exposure to a visible laser (400 to700 nanometer wavelength) at a level below that which causes tissue damage can be a startle hazard, with the individual experiencing temporary impaired vision such as flash-blindness, after images, and glare. Such symptoms may be experienced from an exposure to a Class 2 laser or a Class 3R visible laser, in particular for laser wavelengths near the middle of the visible spectrum (for example, green wavelengths). The symptoms should resolve within a few minutes. If a person is startled from such an exposure while performing a task, it could cause an injury.

2.2.2 Eye Injury

Eye injury to the cornea, lens, and retina is possible from exposures to Class 3B and Class 4 laser beams. The extent of damage depends on the exposure parameters, such as wavelength, power or pulse energy, and the length of exposure. There are three damage mechanisms:

1. **Photothermal.** Laser energy is transferred to the cells as heat.
2. **Photochemical.** Laser energy causes photochemical reactions, such as breaking bonds.
3. **Photomechanical.** Pulsed lasers can cause damage from shock and acoustic waves.

Symptoms of an eye injury can include

- Headache
- Seeing a flash
- Excessive watering in the eye
- Sudden appearance of floaters
- Sudden decrease in central vision
- Central scotoma: a dark or blank spot in the center of vision, corresponding to foveal photoreceptor damage
- Persistent afterimage: a bright or colored spot that lingers in the visual field after exposure
- Blurred vision: general reduction in visual clarity, especially for near tasks, resulting from outer retinal layer disruption

The consequences of the exposure depend on which part of the eye is damaged and by how much the exposure exceeds the *maximum permissible exposure (MPE)* limit (values for the MPE are below known hazardous levels and can be obtained from the LSO or ANSI Z136.1). Lesions from lesser exposures are more likely to heal than those from exposures that greatly exceed the MPE limits.

- **Cornea.** This is the transparent layer of tissue covering the eye. Damage to the outer cornea may be uncomfortable (usually a gritty feeling) or painful, but it normally heals fairly quickly. Damage to the deeper layers can be permanent.
- **Lens.** Beneath the cornea is the iris and behind that is the lens. The iris opens and closes to control the amount of light entering the eye through the pupil. A person’s eye color is determined by pigmentation in the iris.

- **Retina.** The cornea and lens act together to focus incoming light onto the retina to spot sizes as small as 10 to 20 micrometers in diameter. A small area of the retina contains the macula and fovea. This area provides the most detailed and acute vision, as well as color perception. Damage to the fovea can have significant impact on your vision. The rest of the retina can perceive light and movement, and provides peripheral vision, but not very detailed images. Any damage to the retina will ultimately affect vision.

Laser light absorption and its effect on various parts of the eye are wavelength dependent:

- **Ultraviolet wavelengths** (180 to 400 nanometers) can cause damage to the cornea and lens but do not penetrate to the retina. Cataracts forming in the lens are possible from chronic exposure to excessive UV radiation.
- **Visible wavelengths** (400 to 700 nanometers) are focused onto the retina and can damage it (at much lower exposure levels than those required to damage the lens or cornea).
- **Near-infrared wavelengths** (700 to 1,400 nanometers) can also reach the retina and can damage it. Wavelengths between 1,200 and 1,400 nanometers do not transmit and focus onto the retina very well and MPEs for the cornea and retina need to be considered separately in this region.
- **Mid- and far-infrared wavelengths** (1,400 nanometers to 1 millimeter) are absorbed by the cornea and lens and are converted to heat which can cause damage.

2.2.3 Skin Injury

Skin MPEs are similar to those for the eye for UV and mid-far infrared wavelengths but are much higher than those for the eye for visible wavelengths and wavelengths between 700 and 1,200 nanometers. Consequences for a skin injury are less severe than for an eye injury because of the critical importance of good vision and also because skin injuries often heal well. Severe skin burns can result from exposure to Class 4 lasers. Skin injuries are also possible from exposure to Class 3B UV lasers. Skin cancer and skin aging are also possible, in particular for excessive chronic exposure to UV.

2.2.4 Prompt and Delayed Effects

Symptoms from a hazardous exposure to visible and infrared wavelengths are usually prompt. Some people with an eye injury from a visible or near-infrared laser exposure report seeing a flash and then hearing a pop from inside their eye (a photoacoustical effect that may occur with retinal damage).

Note Symptoms from a hazardous exposure to UV radiation may be delayed (possibly by hours), similarly as for a sunburn exposure.

3 General Requirements

Laser safety requirements depend on three factors:

1. The laser classification: each laser is assigned a classification (Class 1, Class 2, Class 3R, Class 3B, or Class 4) based on the level of its accessible radiation and the associated ability of the laser beam to cause injury to the eye or skin. For example, a Class 4 laser is capable of causing greater injury than a Class 3B laser.
2. The environment in which the laser is used, including access to the beam path (considering such factors as *enclosures* and *barriers*).
3. The personnel who may use or be exposed to laser radiation.

3.1 Hazard Control Hierarchy and Control Requirements

When practical, a laser source should be replaced with a non-laser source (elimination) or a lower power laser should be used in place of a higher power laser (substitution) to eliminate or reduce a laser hazard. Laser hazards are then controlled with a combination of *engineering* and *administrative controls* and *personal protective equipment (PPE)*. Engineering controls are given higher priority because they are the most reliable. If possible, they are used to eliminate the laser hazard by fully enclosing the laser beam. Class 3B and Class 4 laser operation requires significant engineering, administrative, and PPE controls. There must be sufficient redundancy of controls (defense in depth) to ensure safe laser operations with minimal risk for injury. There should be no single points of failure that could result in a hazardous exposure. The figure below illustrates the hazard control hierarchy.

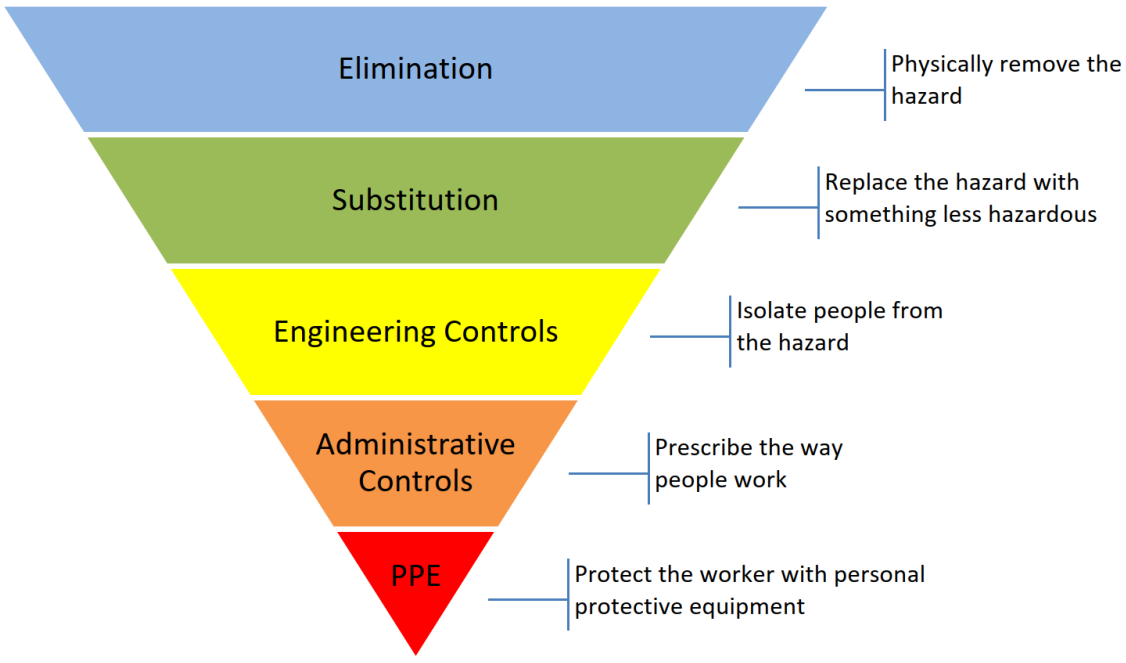

Figure 1 Hazard Control Hierarchy

To ensure engineering controls are effective, they must have good integrity, be reliable, and be implemented in accordance with the SLAC Conduct of Engineering Policy.

3.2 Hazard Analysis and Requirements for Credited and Non-credited Controls

Laser hazard analysis is performed by the SLSO and the LSO to determine the controls requirements to mitigate the associated risks for injury.

- *Credited controls* must be used to reduce risk to an acceptable level.
- Additional *non-credited* controls should be used to further reduce the risk to a level that is as low as reasonably practicable (ALARP).

Laser hazard analysis and requirements for credited controls follow SLAC's general policy requirements for these in General Policy and Responsibilities: Hazard Control Selection and Management Requirements.

For Class 3B and Class 4 laser operation, all of the following controls are generally considered to be credited controls:

- An engineered *laser safety system (LSS)*
- *Standard operating procedures (SOPs)*, including Laser Safety: Core Laser Safety Practices
- Laser eyewear PPE
- Laser worker training (see Section 4, "Training", in Chapter 10, "Laser Safety".)

3.2.1 Interfaces between Safety Systems

When an engineered LSS for a Class 3B or Class 4 laser system has an interface with another system (such as a radiation safety system) that affects the LSS safety functions and is the responsibility of a different group, the interface, configuration control, and responsibilities must be described in an interface control document (ICD). Additional requirements for ICDs can be found in the Laser Safety Systems Technical Basis Document.

3.3 Project Management Requirements

A project is initiated when implementing a new *laser facility* or laser system or making a significant upgrade to an existing facility or system. As applicable, the SLAC Conduct of Project Management Policy and the General Policy and Responsibilities: ESH Project Review Procedure must be followed.

3.4 Alternate Controls

Alternate controls may be used to replace control requirement(s) in this document, provided all of the following requirements are met:

- They provide equivalent protection as would be accomplished with the specific control(s) not used.
- They are reviewed and approved by the LSO.

- Training on them is provided to all affected laser workers.

Alternate controls may be needed when the primary controls specified in this document are not feasible or not reasonably practicable.

Situations where an alternate control may be needed include

- Acceptance testing of a newly received laser
- Service work by a service subcontractor

Examples of alternate controls include

- No unattended operation
- A guard being posted
- An enclosure, if not interlocked, is secured and has a warning label

3.5 Unattended Operation

Only Class 1 lasers or laser systems will be used for unattended operation in unsupervised areas without the implementation of additional control measure requirements.

3.6 Exposure Control

The following controls are recommended for all laser classes above Class 1 to minimize the risk from potential exposure to laser beams:

- Use the minimum laser radiation required for the application.
- Avoid eye and skin exposure and direct viewing of the laser beam; maintain the beam at a level other than the eye level of a person sitting or standing.
- Limit potential exposure levels to as far below the MPE values as is practical.

3.7 Protective Housing

A laser must be contained in its appropriate *protective housing* to reduce potential exposure. The aperture through which the useful beam is emitted is not part of the protective housing. Special safety procedures may be required when protective housings are removed.

The protective housing must

- Limit the maximum accessible laser radiation to a level that defines the classification
- Have classification labels affixed on a conspicuous part of the laser housing
- Limit access to other associated radiant energy emissions and to electrical hazards associated with components and terminals

3.8 Laser Equipment Labels

All lasers must have equipment labels on the protective housing that specify their classification, wavelength, pulse duration (if appropriate), and maximum output power.

Equipment labels have an associated signal word:

- CAUTION for Class 2 and Class 3R lasers

  Note Commercial lasers may use DANGER for Class 3R, which is acceptable.

- WARNING for Class 3B and for most Class 4 lasers

  Note Commercial lasers may use DANGER for Class 3B and Class 4, which is acceptable.

- DANGER for Class 4 lasers that have very high power, pulse energy or irradiance (for example, >100 W average power, >1 J pulse energy, or $>10^{16}$ W/cm^2)

Templates for labels are available on the Laser Safety Program Site.

3.9 Work Planning and Control

Laser operations must comply with SLAC *work planning and control (WPC)* requirements (see Chapter 2, "Work Planning and Control"). WPC requirements for laser safety when working with Class 3B and Class 4 lasers include the following:

- Work by *qualified laser operators (QLOs)* and *laser controlled area workers* in their own laser facility is considered resident-area, yellow work. Authorization and release is granted by the workers being qualified and approved (via the Laser Safety Tool, which also documents the workers' facility-specific work authorizations). When working outside their home facilities, they are limited to *service* work and additional requirements apply. (See Laser Safety: Class 3B and Class 4 Laser Operation Requirements.) Work performed by *service* subcontractors is considered red work and is authorized and released following Laser Safety: Laser Service Subcontractor Work Planning and Control Procedure.
- A *lab-specific SOP* or *job safety analysis (JSA)* is used to describe hazards and controls associated with the work. Laser work may only begin after these documents and the laser laboratory itself have been approved.
- Pre-job briefings must be held as appropriate, and are recommended for new tasks, unfamiliar or infrequently performed tasks, significant configuration changes, or returning system to operation following a downtime or power outage.

Additional requirements apply when laser work is performed by service subcontractors (see Laser Safety: Laser Service Subcontractor Work Planning and Control Procedure).

For details, see Laser Safety: Class 3B and Class 4 Laser Operation Requirements.

3.10 Purchasing Lasers and Laser-protective Eyewear

The LSO must be notified of all purchases of Class 3B and Class 4 lasers and of laser eyewear protection. The LSO must also be notified of all purchases of Class 1, Class 2, or Class 3R lasers with an embedded Class 3B or Class 4 laser, except for the following exempted consumer laser products:

- Class 1 optical disc products such as CD or DVD players or recorders
- Class 1 products intended for home or office use, such as conventional laser printers (laser engravers and 3-D laser printers are NOT exempt)

Note Online purchase requisitions have a section for the requester to complete on whether the purchase includes purchase or service of a laser of any class, or the purchase of laser protective eyewear; with an affirmative response the LSO will be notified automatically.

Purchased laser products should meet the Food and Drug Administration (FDA) requirements in 21 CFR 1040.10 and 21 CFR 1040.11, except as described in FDA Laser Notice 25 and FDA Laser Notice 56. Certification requirements for manufacturers of laser products are described in 21 CFR 1010.2.

A laser product's compliance with FDA requirements will be reflected in its certification label. If the certification label is not present, the LSO will evaluate the laser product's compliance with FDA requirements and provide guidance for implementing additional controls.

Note Laser components are exempt from FDA requirements (see 21 CFR 1040.10)

Note Laser manufacturers have a responsibility to comply with the FLPPS for laser products that are sold in the United States.

3.10.1 FDA Laser Notice 25 Products

This policy is applicable to procurement requests to a manufacturer for specialized laser products that the manufacturer does not already make available for customers to purchase. This policy is not applicable to procurement requests to a manufacturer for a laser product that the manufacturer already makes available for customers to purchase.

Laser Notice 25 was issued following a request by the Department of Energy (DOE) to the FDA to exempt certain laser products from the FLPPS. The request noted that such laser products would be

- Procured from a manufacturer for use as a component in a research and development system or for use in a unique research application,
- Owned by and used solely at a DOE or DOE government owned contractor operation (GOCO) facility, and
- Operated according to the facility's health and safety program standards to ensure the end users as well as members of the public would be protected.

The request stated that an exemption from the FLPPS for such laser products would provide needed design flexibility for DOE and relieve manufacturers of unnecessary reporting and recordkeeping requirements.

Purchased laser products that utilize FDA Laser Notice 25 are required to

- Have an equipment label stating the exemption and that the product should not be used without adequate protective devices and should not be disposed of through excess or regular surplus property channels
- Include, to the extent practical, the safety provisions of 21 CFR 1040.10 and 21 CFR 1040.11. Adequate alternative safety controls are to be provided wherever this is not practical.
- Have written authorization from the DOE to the laser manufacturer to sell or transfer each exempt laser product

The LSO must be informed of a laser purchase utilizing FDA Laser Notice 25, and SLAC must submit a report to DOE for such a purchase.

3.10.2 FDA Laser Notice 56 Products

This policy is applicable for laser products that are certified according to the IEC 60825-1 laser product safety standard rather than the FLPPS. Among other requirements, laser products for introduction into United States commerce, including imports, that utilize FDA Laser Notice 56, must

- Comply with 21 CFR 1040.10 and 1040.11 as applicable
- Be certified and identified in accordance with 21 CFR 1010.2 and 1010.3
- Be reported in accordance with 21 CFR 1002.10

Laser products that are not considered a medical device and utilize FDA Laser Notice 56 are required to have a certification label stating

- “Complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.” or
- “Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.”

3.10.3 FDA Requirements for Class 3B and Class 4 Laser Products

FDA requirements for Class 3B and Class 4 laser products include

- Equipment label
- Certification label
- Protective housing
- Operation manual and servicing procedures
- Key-actuated master control
- Activation warning system and emission indicator
- Remote interlock connector

3.10.4 Receiving Laser Products

When purchased laser products are received, the equipment custodian should

- Review the safety section in the laser's manual
- Verify that the required equipment labels are present
- Inspect the laser systems' electrical equipment to determine if the equipment is listed or requires inspection and approval under the Electrical Equipment and Inspection Program before use (see Section 2.13).

3.11 Manufacturing a Laser and FDA Compliance

SLAC must comply with the FLPPS if it builds a laser product from components or modifies a commercial laser product and then provides this laser product to a non-DOE site. Such transfer of a DOE-built or DOE-modified laser product to a non-DOE site is considered as a commercial enterprise.

3.11.1 Exemption for Laser Products per FDA Laser Notice 14

FDA Laser Notice 14 was issued to "all potential manufacturers of laser products" to clarify when such entities are required to comply with the FLPPS. This policy requires compliance with the FLPPS when a laser product is produced on a continuing basis in the course of a commercial enterprise and is used by personnel not directly involved in its manufacture.

A laser product that is built at SLAC from components or is a commercial laser product that is modified at SLAC, is exempt from FDA manufacturer requirements if it is used exclusively at SLAC or another DOE site. Such a laser product, even if transferred to another DOE facility, is not made as part of a commercial enterprise and is exempt from the FLPPS.

3.12 Electrical Safety Inspection

Laser systems' electrical equipment should be certified and listed for use in the United States by a nationally recognized testing laboratory (NRTL) whenever possible. NRTL-listed laser systems that are used within the listing agency and manufacturer requirements are acceptable for use at SLAC without any additional electrical safety inspection.

Non-listed equipment must be inspected according to the requirements of Electrical Safety: Unlisted / Unlabeled Electrical Equipment Acquisition Requirements and be approved before use.

Additional guidance for electrical safety requirements for laser purchases can be found in Guidance for SLAC System Laser Safety Officers.

3.13 Laser Use for Demonstrations and Events

Lasers used for demonstrations and events at SLAC outside of *laser controlled areas* must meet the requirements listed below, except for laser pointers used for presentations, which are subject to

requirements in Laser Safety: Laser Pointer Requirements. Participants at these demonstrations and events can include the general public and SLAC personnel who are not laser workers.

- Lasers will not exceed Class 3R. Class 1, Class 1M, Class 2, Class 2M, and Class 3R lasers are allowed.

  Important Class 3B and Class 4 lasers may only be operated in a laser controlled area, with approval from the SLAC LSO.

- Class 2 lasers should be used instead of Class 3R lasers, if practical. Visible lasers (400–700 nm wavelength) should be used unless the point of the demonstration can only be accomplished with an invisible laser.
- Laser use will be supervised by a SLAC laser worker (QLO or LCA worker) or a SLAC employee who has completed ESH Course 132, Laser Safety Basics (ESH Course 132).
- Requirements in Section 3.6, “Exposure Control”, will be followed.
- Laser beam paths will be controlled and will not be directed towards participants.
- Laser use must be reviewed and approved by the LSO. The LSO will determine appropriate controls, including any laser safety instruction that must be given to participants.

4 Forms

The following forms and systems are required by these requirements:

- Laser Safety Tool. System used for maintaining information on laser personnel and facilities, including approvals of facilities and qualified laser operators and laser controlled area workers

5 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- None

6 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 10, “Laser Safety”
  - Laser Safety: Laser Pointer Requirements (SLAC-I-730-0A05S-010)v
  - Laser Safety: Class 2 and Class 3R Laser Operation Requirements (SLAC-I-730-0A05S-003)
  - Laser Safety: Class 3B and Class 4 Laser Operation Requirements (SLAC-I-730-0A05S-004)
  - Laser Safety Systems Technical Basis Document (SLAC-I-730-0A05Z-001)
  - Laser Safety: Class 3B and Class 4 UV Laser Operation Requirements (SLAC-I-730-0A05S-012)
  - Laser Safety: Laser Worker Approval Procedure (SLAC-I-730-0A05C-003)

  - Laser Safety: Laser Service Subcontractor Work Planning and Control Procedure (SLAC-I-730-0A05C-001)
  - Laser Safety: Core Laser Safety Practices (SLAC-I-730-0A05S-006)
  - Guidance for SLAC System Laser Safety Officers (SLAC-I-704-701-004-00)
  - Laser Safety Program Site (SharePoint)
- Chapter 1, "General Policy and Responsibilities"
  - General Policy and Responsibilities: ESH Project Review Procedure (SLAC-I-720-0A24C-001)
  - General Policy and Responsibilities: Hazard Control Selection and Management Requirements (SLAC-I-720-0A24S-001)
- Chapter 2, "Work Planning and Control"
- Chapter 8, "Electrical Safety"
  - Electrical Safety: Unlisted / Unlabeled Electrical Equipment Acquisition Requirements (SLAC-I-730-0A11J-004)

Other SLAC Documents

- SLAC Conduct of Engineering Policy (ENG-2018-018)
- SLAC Conduct of Project Management Policy (PM-2018-034)
- ESH Course 132, Laser Safety Basics (ESH Course 132)

Other Documents

- Title 21, *Code of Federal Regulations*, "Food and Drugs, Chapter 1, "Food and Drug Administration, Department of Health and Human Services", Subchapter J, "Radiological Health", Part 1002, "Records and Reports", Subpart B, "Required Manufacturers' Reports for Listed Electronic Products"
  - Section 1002.10, "Product Reports" (21 CFR 1002.10)
- Title 21, *Code of Federal Regulations*, "Food and Drugs, Chapter 1, "Food and Drug Administration, Department of Health and Human Services", Subchapter J, "Radiological Health", Part 1010, "Performance Standards for Electronic Products: General"
  - Section 1010.2, "Certification" (21 CFR 1010.2)
  - Section 1010.3, "Identification" (21 CFR 1010.3)
- Federal Laser Product Performance Standard (FLPPS): Title 21, *Code of Federal Regulations*, "Food and Drugs, Chapter 1, "Food and Drug Administration, Department of Health and Human Services", Subchapter J, "Radiological Health", Part 1040, "Performance Standards for Light-emitting Products"
  - Section 1040.10, "Laser Products" (21 CFR 1040.10)
  - Section 1040.11, "Specific Purpose Laser Products" (21 CFR 1040.11)
- Food and Drug Administration (FDA) Laser Notice 14, "Lasers Manufactured and Used In-House" (FDA Laser Notice 14)
- Food and Drug Administration (FDA) Laser Notice 25, "Exemption of Certain Laser Products Used Exclusively by the Department of Energy or its Contractors, and by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce" (FDA Laser Notice 25)

- Food and Drug Administration (FDA) Laser Notice 56, “Laser Products – Conformance with IEC 60825-1 Ed. 3 and IEC 60601-2-22 Ed. 3.1; Guidance for Industry and FDA Staff” (FDA Laser Notice 56)
- American National Standards Institute (ANSI) Z136.1, “Safe Use of Lasers” (ANSI Z136.1)