

LASER INTERFEROMETER GRAVITATIONAL WAVE
OBSERVATORY

- LIGO -

California Institute of Technology
LIGO Livingston Observatory

Document Type LIGO-M990148-00-L

3-27-99

LIGO Livingston Observatory
Laser Safety Plan

Douglas G. Cook / Jonathan Kern

Approved:

Site Manager

LIGO Safety Engineer

Project Manager

LIGO Hanford Observatory
P.O. Box 1970; Mail Stop S9-02
Richland, WA 99352
Phone (509) 372-2325
Fax (509) 372-2178
E-mail: info@ligo.caltech.edu

California Institute of Technology
LIGO Project - MS 18-34
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

LIGO Livingston Observatory
19100 LIGO Lane Road
Livingston, LA 70754
Phone (225) 686-3100
Fax (225) 686-7189
E-mail: info@ligo-la.caltech.edu

Massachusetts Institute of Technology
LIGO Project - MS 20B-145
Cambridge, MA 01239
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

WWW: <http://www.ligo.caltech.edu>

1 GENERAL

1.1 Purpose

This document outlines the laser safety procedures which are to be implemented at the **LIGO Livingston** site.

1.2 Scope

This document contains essentials related to the overall laser safety in the laboratories, and is designed to ensure the safety of all personnel, equipment and visitors, and is based on:

1. American National Standard for "Safe Use of Lasers" ANZI Z136.1-1993.
2. LIGO Laser Safety Program, LIGO-M960001-P.

1.3 Authority and Responsibility

The LIGO Project is responsible for the application of safety requirements and the operating safety of the Project's laser systems. A complete description of responsibilities are provided in the LIGO Project System Safety Plan, LIGO-M950046. Everyone attached to LIGO (all staff members and employees) are personally responsible for safety and safe practices. All individuals must identify hazards and bring them to the attention of the group leaders, Safety Officer, or Project Manager. There shall be a designated **Laser Safety Officer (LSO)** for the LIGO Observatory at Livingston.

A. Laser Safety Officer

The LSO has the responsibility and authority to monitor and enforce the control of laser hazards at the Livingston facility. In addition, the LSO will be responsible for the following tasks:

- Maintaining an inventory of all lasers operating at the facility. Inform LIGO Livingston Safety Officer of any new laser installations.
- Maintaining an up-to-date listings of the laser system Sponsors, and those who have completed the "Basic" laser safety training. The names of the qualified Registered Laser Personnel are to be posted outside the Laser Control Areas, near the entrance.
- Providing the necessary safety equipment for safe operation of laser systems.
- Coordinating of "baseline" and "termination" eye exams.
- Ensuring that the required Standard Operating Procedures are posted, and that proper warning equipment, signs, labels, emergency procedures, per ANSI Z 136.1 are in place.
- Providing "Basic" laser safety training seminars for workers and others that may work around, or in the vicinity of lasers.
- Scheduling quarterly laser safety inspections, and inspecting new laser systems when placed in operation.
- Identifying laser wavelength and assigning laser system classification.

B. Laser system Sponsor

Sponsors are experienced laser personnel who have a need to install a laser system.

- Sponsors should understand the LIGO Laser Safety Program, have an understanding of *this* document and have completed the LIGO Livingston "Basic" Laser Safety Program.
- Sponsors prepare and obtain approval of Standard Operating Procedures (SOP) for their laser system.
- Any time one or more persons will be working on the laser system, ONE person shall be designated the "Responsible Laser Operator". The name of that person shall be posted at the entrance to the Laser Control Area. This person coordinates the activities on or in the vicinity of the laser system.
- All laser systems are to have restricted access, entered only by Registered Laser Personnel authorized by the system Sponsor or the LSO. (see Registered Laser Personnel, below) All others must be escorted by one of the Registered Laser Personnel.
- Sponsors must supply any additional specific precautions and a copy of the SOP to each "Registered Laser Personnel" that they authorize.
- Sponsors are to maintain and post a current list of "Registered Laser Personnel", with Sponsors signature and date.

C. Registered Laser Personnel

Registered Laser Personnel are persons needing to enter or work in a Laser Control Area (restricted access area), without an escort.

- Registered Laser Personnel must have successfully completed the **LIGO Basic Laser Training** (See Basic Trained Personnel, below).
- Registered Laser Safety Personnel must have read, understood and have been given a copy of *this* document.
- Registered Laser Personnel should assist the Sponsor and/or LSO in identifying any potential laser-related safety hazards.
- Registered Laser Personnel are responsible for conducting all activities in accordance with the approved **Standard Operating Procedure** and with all requirements of the **LIGO Livingston Observatory Laser Safety Plan**.
- Registered Laser Personnel are responsible for the laser safety of all personnel they escort into a Laser Control Area. (restricted access area)

D. Basic Trained Personnel

Basic Trained Laser Personnel have met the minimum mandatory requirements for working around lasers at LIGO Livingston Observatory.

- Basic Trained Laser Personnel must have completed the required Laser Referral Eye Exam (the "Baseline" exam) Appendix 1 of *this* document.
- Basic Trained Laser Personnel must have viewed and understood the two Laser Safety Videos. Tape 1 "Introduction to Laser Safety and Laser Hazards" and Tape 2 "Medium and High- Power Lasers"
- Basic Trained Laser Personnel must understand the Hazards and the Personnel Protective Equipment associated with working around the LIGO laser systems.
- Basic Laser Trained Personnel must have read and understood *this* document and have a copy.
- Basic Laser Trained Personnel must know the LLO Emergency Procedures.
- Basic Trained Laser Personnel must have signed of copy of the **Basic Trained Laser Personnel Registration Form** (Appendix 2).

E. Visitors

If a visitor is to enter a **Laser Control Area** (restricted access area) governed by an **SOP**, they must be escorted by a **Registered Laser Personnel** for that system. Visitors require the proper safety eyewear when required, and their acknowledgment that laser hazards exist.

2 STANDARD OPERATING PROCEDURES

Standard Operating Procedures (SOPs) are to be written by a Sponsor for each laser system to establish proper guidelines for safe use. A series of document control numbers have been reserved for this purpose. Those documents are to be a sub-part of *this* document and will be traceable to *this* document. SOPs are to be approved by the Laser Safety Officer and the Livingston Site Safety Officer. A copy of the approved SOPs are to be kept at the entrance of the laser control area.

2.1 Laser Control Areas

Laser control Areas include the **LVEA, VEAS, Optics Lab, Vacuum Preparation and Assembly, Cleaning and Active Storage Areas**. These areas will follow *this* guideline, along with individual SOPs which govern each specific laser system or Laser Control Area. A copy of these additional SOPs will be kept, along with this document, at the entrance to each Laser Control Area. All approved SOPs, appropriate signs, labels, lists, controls, etc., are to be in place before these systems are allowed to operate.

A. Standard Operating Procedures should include:

- Layouts showing **Nominal Hazardous Zone** and **Maximum Permissible Exposure Areas**. Specifics for calculations can be found in the ANSI Z 136.1 manual. Layouts are to be configured to optimize safety without minimizing functionality. It may be necessary to define the entire Laser Control Area as the NHZ
- Identification of the laser system and its classification so as to apply proper safety requirements per ANSI Z 136.1 specifications for that class of laser.
- Such things as whether the laser should be operated within a localized enclosure, or in a controlled work area, etc.
- Eye protection for the appropriate type and class of laser, must be available to all personnel, including visitors for each laser system or area. The eyewear should provide maximum attenuation of the laser light while transmitting the maximum amount of ambient light.
- Written personnel warning to avoid things such as looking into the beam, even when wearing eye protection.
- Notations about work habits to include limiting the scatter of laser light to a minimum by maintaining proper alignment of optics, use of beam dumps and making sure optics are secured to the optics table.
- Viewing equipment available to view scattered or stray light.
- Specified, appropriate clothing should it be available necessary.
- Suitable shielding, to be used between the laser beam and personnel or flammable surfaces when the laser beam irradiation is sufficient to be a serious skin or fire hazard.
- Procedures for proper use of beam shutters, polarizers, filters, etc.

- Warning signs that illuminate upon powering up lasers, or through the use of procedures, are to be located at the entrances to Laser Control Areas.
- Placards defining all other related hazards posted at entrances.
- Additional warnings regarding things such as microscope viewing systems that must be guarded against reflected laser radiation returning through the optics.
- Procedures to ensure that the laser cannot be operated from a remote position while personnel are in the vicinity of beam paths.
- Before and during insertion or removal of any optical component, the power of all affected laser beams shall be reduced to safe workable levels.
- Immediately after inserting, removing, or making significant adjustments to any optical component, the vicinity of the optical table or the controlled work area shall be scanned to ensure that all stray beams are dumped.
- Multiple independent activities involving manipulation of laser beams shall not occur simultaneously. Any time the laser beams will be manipulated, e.g. by inserting, removing, or adjusting any optical components, persons not directly participating in the beam manipulation activity will move to a safe location until the activity is completed.
- Each time the laser will be left running unattended, the vicinity of the optic tables or controlled work area shall be scanned for stray beams immediately prior to vacating the controlled work area. The "unattended" status of the laser shall be posted near the controlled work areas.

2.2 Training

All personnel requiring unescorted access to a Laser Control Area, must become a Registered Laser Personnel as outlined in *this* document. Registered Laser Personnel must have already completed the requirements of Appendix 2. Training shall follow the outline of ANSI Z 136.1 and LIGO Safety Procedures. SOP Sponsor shall provide additional training specific to particular laser installations.

2.3 Additional Hazardous Areas

Additional laser related hazards, such as fire, electrical shocks, chemical hazard, etc., are to be an integral part of the individual SOP. Avoid wearing rings, watches and other jewelry while working on or around systems.

3 EYE EXAMS

All personnel requiring unescorted access to a Laser Control Area, must become a Registered Laser Personnel and are required to take a "Baseline" eye examination before being allowed into these areas. The "Termination" eye exam is required upon terminating employment. These requirements reflect those stated in ANSI Z 136.1, 1-1993. For visiting staff and others who have taken their eye examination elsewhere, it will be necessary to sign and date the appropriate acknowledgment form with the LSO (Ref. Appendix 2) stating that an eye exam was completed prior to coming to the Livingston site.

3.1 Exclusions

Visitors, short-term and incidental workers may be excluded from the eye examination requirement.

4 REFERENCES

4.1 American National Standards Institute

American National Standard for Safe use of Lasers, ANSI Z 136.1-1993, published by the Laser Institute of America, Orlando, Florida.

4.2 LIGO Laser Safety Plan

LIGO-M960001-A-P, dated March 25, 1996.

APPENDIX 1

Eye exams, where performed:

Ralph Maxwell III, M.D.
1705 S Morrison Boulevard
Hammond, Louisiana
(504) 345-2020

Dr. Maxwell and his staff are available for laser eye emergencies should an incident occur.

A. Laser Referral Exam Shall Include:

1. Ocular history
2. Slit lamp examination of cornea, iris and lens.
3. Ophthalmoscope examination of fundus with pupil dilated.
4. Fundus photographs
5. Visual acuity
6. Amsler Grid Test
7. Refractory eye exams are available upon request for prescription safety eyewear for Livingston personnel working around laser systems on a regular basis. The prescriptions will be forwarded to the eyewear manufacturer for processing. Upon completion, eyewear shall be fitted by an optometrist.
8. Medical eye history form to be completed and forwarded to the site LSO.

B. Records

A copy of exam records and photographs will be considered confidential and are to be included in the employee records at Caltech LIGO. Personnel to work at this site, who are coming in from other facilities should transfer a copy of their eye exam records to this office or sign the appropriate acknowledgment form (ref. Appendix 2) with the Livingston LSO.

C. Emergencies

A list of emergency contact numbers must be posted at the entrances to all Laser Control Areas. This list will include phone numbers to be used for both during and after work hours.

In case of a laser incident:

1. Notify the site LSO and LIGO Livingston Safety Officer.
2. Report to the applicable Medical department for exam and/or treatment.
3. File a Laser Incident Report (LIGO-M960001-A-P Appendix A).

APPENDIX 2

Basic Trained Laser Personnel Registration Form

The undersigned personnel:

1. Will comply with the LIGO Livingston Observatory Laser Safety Plan LIGO-M990148.
2. Has viewed and are familiar with the two Laser Safety Videos: Tape 1- "Introduction to Laser Safety and Hazards" and Tape 2- "Medium and High Power Lasers"
3. Has read and understands the LIGO Livingston Observatory Laser Safety Plan, LIGO-M990148, and has been given a copy.
4. Has an general understanding of the Hazards and the Personnel Protection Equipment associated with working around the LIGO laser systems
5. Has the personnel protective equipment available to them and is familiar with their care and use.
6. Knows where the Laser Control Areas are located and that access to these Laser Control Areas are **restricted**, and to be entered only when accompanied by a Registered Laser Personnel **or** if they themselves have satisfied the requirements of the Standard Operating Procedure and their name appears on the list of approved Registered Laser Personnel for that system.
7. Knows the location of the laboratory copy of the ANSI Z 136.1-1993, "American National Standard for the Safe Use of Lasers".
8. Knows the location and operation of protective equipment, such as Eye wear, Curtains, Emergency Laser Stop Buttons.
9. Knows the Site Emergency Procedures.
10. Has completed the Ophthalmologic eye exam as described in Appendix 1 of the LIGO Livingston Observatory Laser Safety Plan.

Through LIGO, Livingston: _____ Date: _____

At a remote location: _____ Date: _____

Basic Trained Laser Personnel: _____ **Signature** _____

Laser Safety Officer: _____ **Signature** _____

Date: _____