

# **Laser Safety Procedures**

**Chemistry Division  
Argonne National Laboratory**

**Latest Version July 2002**

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**Introduction**

The purpose of this document is to establish the Chemistry Division (CHM) procedures and policies for complying with the Department of Energy (DOE), ANSI Standards, and Argonne National Laboratory (ANL) laser safety requirements. Each Laser Controlled Area (LCA) shall operate under a reviewed and authorized (by line management signature) SOP. This SOP shall provide operation guidance and policy for the site specific hazards contained within the LCA.

**Identification of Laser - Specific Hazards**

Beams from lasers, specular reflections of these beams, and even diffuse reflections of such beams that have sufficient power or energy can cause permanent damage to the eyes or skin. The potential hazards from lasers exist not only for those who are directly involved with the laser, but also for passers-by and even personnel outside the building in which the laser is housed. Concerning questions as to the nature of laser hazards and how they can be controlled, consult with Bruce Murdoch, the ANL-LSO, Gary Dyrkacz the ESH/QA Coordinator or David Gosztola, Chairperson of the CHM Laser Safety Committee.

**Abbreviations Used in Document**

ANL	Argonne National Laboratory
CHM	Chemistry Division
ESH/QA	Environment, Safety, Health & Quality Assurance
ANL-LSO	Argonne National Laboratory - Laser Safety Officer
ANSI Z136.1	“American National Standard for the Safe Use of Lasers -- refers to the latest issue: Z136.1 – 2000
DOE	United States Department of Energy
ESH-IH	Environment, Safety, and Health Division, Industrial Hygiene Section at Argonne National Laboratory
LCA	Laser Controlled Area
SOP	Standard Operating Procedure
CPR	Cardiopulmonary Resuscitation training
MPE	Maximum permissible exposure
ANL ESH Manual	Argonne National Laboratory - East Site Environment, Safety, and Health Manual

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**National Standards and ANL Laser Safety Requirements**

Argonne National Laboratory is required by the DOE to operate all lasers in accordance with the requirements of the latest revision of the American National Standard for the Safe Use of Lasers Z136.1 (ANSI Z136.1). Argonne laser safety responsibilities, practices, procedures, and requirements are described in Chapter 6-2 (Laser Safety) of the ANL Environment, Health and Safety Manual. In the event of a conflict between requirements in the present document and those of either the ANSI Z136.1 or ANL requirements, this document shall be subordinate.

Other useful laser safety information, such as booklets by the Laser Institute of America (i.e. "Laser Safety Guide" and "Guide for Selection of Laser Eye Protection") are available for ready reference in the Building 200 Library (see Appendix C)

**Applicability to Users from Other Divisions**

Users and scientific collaborators from other ANL divisions who work in either Building 200 or Building 211 are reminded that they shall follow the laser safety procedures described herein.

**Laser Class Definition**

The numerical classes of lasers (1, 2, 2a, 3a, 3b, and 4) are defined in the ANSI Z136.1.

**Control Measures for Various Class Lasers**

Chemistry Division imposes no procedural requirements for the use of Class 1, 2, 2a, and 3a, lasers beyond those contained in ANSI Z136.1 and the ANL ESH Manual.

**Safe Use of Lasers -- Administrative and Procedural Controls**

The following procedures are designed to establish clear channels of authority and responsibility for laser hazard evaluation and control.

**Division Director Responsibilities**

The Chemistry Division Director has final decision and approval authority over any laser safety issues or laser use protocols. The Division Director may delegate authority for any part of the approval process to an individual or committee.

**Laser Safety Committee Responsibilities**

The CHM Laser Safety Committee shall advise the Division Director on laser safety issues. The ANL-LSO and the Deputy LSO shall be members of the CHM division laser committee. Other committee members and its Chair shall be appointed by the Division Director from staff scientists who are users of class 3b or 4 lasers within the division. All members of the committee are to be knowledgeable of applicable laser safety standards.

**The specific responsibilities of the Committee include:**

1. The CHM Laser Safety Committee shall convene as need arises, but at least annually, to consider any specific safeguards, practices, or procedures concerning laser use within the division. The Committee will address any issues that have been brought to its attention as being questionable by anyone within the Division. If the committee agrees that corrective action is warranted, it will recommend such action to the ESH/QA Coordinator, and the CHM Division Director.
2. The CHM Laser Safety Committee shall participate in the annual division LCA audits. At least one member of the safety committee will work in association with the ESH/QA Coordinator, and the ANL LSO, to provide a reasonable and comprehensive safety audit of each division LCA.
3. The CHM Laser Safety Committee shall annually submit a written report to the Division Director which shall include any suggested improvements to the laser safety program of the division. Normally, the report will be based on the results of the most recent inspection of Division LCAs (or laser areas with class 3a lasers), as supplied by the CHM Coordinator ESH/QA to the committee, and such other information as is available to the committee.
4. The CHM Laser Safety Committee shall advise and assist the ESH/QA Coordinator in establishing the content of division laser safety training programs, particularly as to recommendations concerning "hands on" use of lasers.

**The Specific Responsibilities for the Chairperson of the CHM Laser Safety Committee include:**

1. The Chairperson of the CHM Laser Safety Committee shall convene meetings of the division Laser Safety Committee as needed but at least annually. The Chairperson shall maintain a record of such meetings.
2. In coordination with the ANL-LSO and with the assistance of the ESH/QA Coordinator, Laser Safety Committee Chairperson shall on a yearly basis, perform inspections of LCAs and class 3a laser areas, assist with the initial review and serve as a resource person on laser safety matters within the Division.

**CHM ESH/QA Coordinator Responsibilities**

The specific responsibilities of the CHM ESH/QA Coordinator concerning laser safety are as follows:

1. The ESH/QA Coordinator shall be knowledgeable of applicable laser safety standards, which include ANSI Z136.1, Chapter 6-2 of the ANL ESH Manual, and this document, *Laser Safety Procedures of the Chemistry Division*.
2. The ESH/QA Coordinator shall annually, or more frequently as needed, verify the authorization of CHM laser users.
3. The ESH/QA Coordinator shall work with group leaders, LCA supervisors, users, and the ANL-LSO to expedite planning and installation of LCAs or laser areas, and their associated laser systems in CHM and grant divisional approval to those installations that meet general division safety standards, as well as division laser safety standards.
4. The ESH/QA Coordinator shall ensure that entrance and exit eye exams have been arranged and completed.
5. The ESH/QA Coordinator shall annually, or more frequently as required, inspect all LCAs for which CHM is responsible and maintain a written record of the results of such inspections. The inspections should be carried out jointly with the Chair of the CHM Laser Safety Committee and the ANL-LSO or his designate. The written results of these inspections shall be furnished to the CHM Division Director, the CHM Laser Safety Committee, and to the group leader and LCA supervisor responsible for each inspected LCA.
6. The ESH/QA Coordinator shall bring to the attention of the CHM Laser Safety Committee any laser-related safety problems appropriate for review by the committee.
7. The ESH/QA Coordinator shall ensure that all personnel using lasers have the proper laser training. The Chair of the CHM Laser Safety Committee should advise or make known to the ESH/QA Coordinator any additions or changes needed in training for any specific areas, as recommended by the CHM Laser Safety Committee.
8. LCA SOPs shall be provided to the ANL-LSO for consideration and recommendation for approval. The ESH/QA Coordinator shall grant divisional approval (by signature) of those LCA SOPs that meet applicable requirements, and promptly transmit division approved SOPs to the originating LCA supervisor responsible for the LCA. This approval authority is granted to the ESH Coordinator at the discretion of the Division Director.
9. When requested by the ANL LSO, the ESH/QA Coordinator shall determine and report the current status of ownership, location, or disposition of specific lasers.

### Group Leader Responsibilities

Group leaders are responsible for adequate control of laser hazards under their supervision. The laser hazards may be to employees, visitors, the general public, or the environment. The group leader responsible for a LCA should be the supervisor of the LCA (see section below entitled *Responsibilities of Laser Controlled Area Supervisors*). However, a Group Leader may choose to delegate the LCA supervisor responsibility for a given LCA to a staff member knowledgeable of laser hazards and methods of controlling such hazards. The Group Leader shall promptly notify the ESH/QA Coordinator, **in writing**, of such delegation of responsibility. Note that such delegation of responsibility for a LCA does not alter a group leader's line management responsibility.

### **Laser Control Area Supervisor Responsibilities**

The specific responsibilities of a LCA supervisor concerning laser safety and the control of laser hazards include, but are not limited to, the following:

1. The LCA supervisor shall be familiar with and adhere to the applicable laser safety standard, notably ANSI Z136.1, Chapter 6-2 of the ANL ESH Manual and this document the *Laser Safety Procedures of the Chemistry Division*
2. The LCA supervisor shall obtain all necessary recommendations from the ANL-LSO, and authorizations and signatures from the ESH/QA Coordinator for approval of the LCA operation.
3. The LCA supervisor shall submit an acceptable written Standard Operating Procedure for the LCA to the ESH/QA Coordinator. (Appendix F provides general Guide for Writing an SOP).
4. The LCA supervisor shall quarterly, or more frequently as needed, inspect the engineering controls of the LCA to ensure maintenance of satisfactory conditions. Inspections will be documented in writing and the documentation retained.
5. For all class 3a, 3b and 4 lasers in the LCA, the LCA supervisor shall obtain the recommendation of the ANL-LSO, and the approval of the CHM ESH Coordinator prior to carrying any of the following actions:
  - a. Initial installation of a class 3a, 3b or 4 laser, whether in an existing or a new LCA or laser area.
  - b. Loan or movement of a class 3a, 3b or 4 laser out of the LCA or laser area where its use was previously authorized. Specifically included is disposal (e.g., "excess") of such lasers.
  - c. Modification of a class 3a, 3b or 4 laser that substantially alters the hazards associated with the laser.
6. The LCA supervisor shall issue appropriate instructions and training materials

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on potential laser hazards and their control to all Users and scientific collaborators under the LCA or laser area.

7. The LCA supervisor shall promptly submit to the ESH/QA Coordinator, in writing, the names of users and scientific collaborators the LCA supervisor authorizes to work with class 3b and 4 lasers in the LCA.
8. The LCA supervisor shall ensure that authorized laser Users, and in some cases scientific collaborators, have completed an entrance eye exam. (Users and collaborators are defined below.) This exam shall be specifically designed to validate the users eye condition prior to work in an CHM laser lab where class 3b and 4 lasers are present. The supervisor shall again ensure that an exit eye exam is completed when work in the LCA is completed by the user or scientific collaborator. The supervisor shall contact the CHM Staff Assistant to arrange for the required eye examinations.
9. The LCA supervisor shall make available to authorized users, authorized spectators, scientific collaborators, and service people, the appropriate protective eyewear. Annually, or more frequently as needed, the supervisor shall inspect such eyewear to ensure maintenance of satisfactory condition. Such inspections shall be documented in writing and documentation retained.
10. The LCA supervisor shall ensure that authorized users and, if required, scientific collaborators of the LCA attend laser safety training programs as required.
11. The LCA supervisor shall ensure that authorized users who work with high voltage are trained in cardiopulmonary resuscitation (CPR) and that they are provided with timely CPR refresher course training.
12. The LCA supervisor shall maintain in or near each LCA entrance, for ready reference:
  - a. A copy of the approved SOP for the LCA.
  - b. A copy of this document, *Laser Safety Procedures of the Chemistry Division*.

### **Laser Users Responsibilities**

User of lasers in CHM shall be familiar with, and adhere to, applicable laser safety standards which include ANSI Z136.1, and Chapter 6-2 of the ANL ESH Manual. The specific responsibilities concerning laser safety of Users of class 3b or 4 lasers with CHM include:

1. Users shall be authorized to operate the laser(s) that will be used. The supervisor for the Laser Controlled Area (LCA) in which the laser is located is responsible for authorizing use of the equipment.

2. Users shall have a special eye examination as prescribed by the ESH/QA Coordinator, prior to beginning use of class 3b or 4 lasers and again upon termination of work with such lasers or at the termination of employment.
3. Users shall be familiar with and adhere to the operating requirements of the specific laser(s) or laser system(s) the user will operate, including the Standard Operating Procedure for the LCA(s) in which such unit(s) will be operated.
4. Users shall promptly report to their supervisor any known or suspected accident involving personal injury or significant damage to Laboratory equipment or facilities. This should not supersede any 911 action.
5. User shall attend CHM divisional and site-wide laser safety training programs as required.
6. User shall wear appropriate protective eyewear whenever operational conditions may result in a potential eye hazard. Such eyewear is to be furnished by the supervisor of the laser controlled area.
7. If working with high voltage, users and safety watches must be trained in cardiopulmonary resuscitation (CPR) and attend required CPR refresher training courses. Users cannot work alone with high voltage.

### **Responsibilities of other personnel in an LCA**

Although it is prudent from the standpoint of safety to restrict the LCA to as few people as possible, there are other personnel who may need access to the LCA. Minimum responsibilities for these other individuals are provided below. An LCA supervisor may insist on more stringent guidelines than those provided here.

### ***Scientific Collaborator Responsibilities***

A Scientific Collaborator is not a laser user and has no direct control over the laser beam, but participates in the experiment in some other capacity. A scientific collaborator shall be provided adequate eye protection as designated in the LCAs Standard Operating Procedure. Scientific Collaborators in CHM shall be familiar with, and adhere to, applicable laser safety standards which include ANSI Z136.1, and Chapter 6-2 of the ANL ESH Manual and this division laser safety document. The specific responsibilities, concerning laser safety for a scientific collaborator in CHM include:

1. A scientific collaborator shall not be permitted to control any laser beams (such as by an external optical element) and shall not handle or manipulate any laser in the LCA.
2. A scientific collaborator shall never be alone in the LCA. An authorized user or

the LCA supervisor shall be present and supervise all activities of the scientific collaborator within the LCA.

3. A scientific collaborator shall not be present while a laser is being aligned.
4. A scientific collaborator shall only be present in the LCA when the beam is enclosed or adequate protection, e.g. eyewear, is in use as designated in the SOP.
5. The actions of a scientific collaborator within the LCA are the direct responsibility of the LCA supervisor.
6. Depending on the nature of their participation, and upon specific approval by the LSO, scientific collaborators may be offered the opportunity to take the Laser Safety Training Course, ESH120.

***Spectators:***

A spectator is defined in the Laser Safety, Section 6.2 of the ANL ESH manual as an individual who observes or watches a laser or laser system in operation, and who may lack appropriate safety training or medical screening. The spectator will not be operating any laboratory equipment. The spectator will not be in close proximity to the beam. The spectator must be provided with maximum protection, e.g. eyewear and laser enclosure.

**Spectator Responsibilities:**

1. A spectator shall never be alone in the LCA. An authorized user shall be present and supervise all activities of the spectator within the LCA.
2. A spectator shall not be present while a laser is being aligned.
3. A spectator present in the LCA shall be provided maximum protection, e.g., eyewear and system enclosure, as designated in the SOP.
4. The actions and safety of a spectator within the LCA are the direct responsibility of the LCA supervisor.

***Visitors:***

A visitor is defined as any person who is not an authorized user, scientific collaborator, or spectator, or any person who has no official need to see the laser system in operation. The visitor classification would apply to individuals who are touring, inspecting, doing maintenance, or custodial work in the LCA.

**Visitor Responsibilities**

1. A visitor is allowed in an LCA only when the laser circuitry is disabled.

2. The actions and safety of a visitor invited into an LCA are the direct responsibility of the LCA supervisor or person allowing the visitor to enter the LCA. Note: The CHM ESH Building Manual provides the general regulations for visitors in laboratories.

***Field Service Engineers:***

The exception to visitors' restrictions are people who must be allowed into the LCA to service laser equipment while it is in operation. These individuals are subject to the standard contractor training, and their responsibilities should be indicated in the Job Safety Analysis document that must be prepared prior to their visit. It is the responsibility of the LCA supervisor to ensure that a service engineer is qualified to do the intended work, and that the service engineer will not be accidentally exposed to beams or stray reflections from other lasers while in the LCA.

**Laser Control Area -- Standard Requirements**

An important objective in devising and implementing laser control measures to minimize the potential for exposure of the eyes or skin to hazardous light levels. To this end, CHM requires that class 3b and class 4 lasers with partially or totally unenclosed laser beams be operated only in approved LCAs. See Appendix C for a schematic diagram of a typical Building 200 laboratory module converted into a LCA. The following are standard requirements for CHM:

1. *Warning Signs*  
A laser hazard warning sign meeting the requirements of ANSI Z136.1, is required at the entrance to the LCA. Contact the ANL-LSO to obtain appropriate signs.
2. *Warning Light Box*  
A warning light system at the entrance to the LCA is required. In order to insure uniformity, warning light systems shall be comparable to those currently used (i.e. those manufactured by Molelectron). The warning light box shall be mounted at eye level (typically between 5' and 6' above the floor) and as near to the door as practical. Three lights shall indicate the status of the laser hazard within the LCA:

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Green	The system is OFF; there are no laser light hazards within the LCA.
Yellow	The laser system is in a standby mode; entrance into the LCA is by permission

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of an authorized user of the LCA. This mode covers all phases of laser operation with the beam shutter in its closed or attenuating position.

Red

The laser is ON; entrance into the LCA is forbidden to anyone other than the authorized users of the LCA. In this mode, the beam shutter is open and the interlock on the entrance to the LCA is operational (i.e. unauthorized entry into the LCA will cause the beam shutter or equivalent to block the laser beam).

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3. *Interlocked Beam Shutter or Equivalent*

A beam shutter or attenuator shall be mounted near the primary output of the laser and interlocked to the entrance of the LCA. In the event of unauthorized entrance into the area, the shutter or attenuator shall reduce the laser output to, or below the appropriate maximum permissible exposure level as defined in ANSI Z136.1. Operator intervention shall be required to open the beam shutter or reactivate the laser. To facilitate authorized access and egress, a temporary override of the interlock may be installed. Such an override shall not be prominently displayed and may not be operational for more than 30 seconds. The shutter or attenuator may be replaced by appropriate deactivation of the laser power supply.

4. *Multiple Lasers Within a Single LCA*

When two or more lasers are within a single LCA and are not part of a single experiment, they shall be set up in such a way that they may be independently and simultaneously operated as if each were in its own LCA. In particular, primary laser beams and specular and diffuse reflections of laser beams shall be confined to within a single experimental area or enclosed while transiting other experimental areas.

5. *Restrictions On Use of Non-related Equipment in a LCA*

To the extent possible, equipment not utilized in laser experiments should not be located or stored within a LCA. If it is impractical to relocate such equipment, such equipment shall not be operated or retrieved from storage while the laser is activated.

6. *"ON" Indicator*

All lasers capable of producing a beam containing only invisible light shall have an "On" indicator which is clearly visible or audible from any work location

within the LCA. Distinct noises produced by a pulsed laser will normally suffice to meet this requirement.

7. *Prevention of Unauthorized Operation*

All class 4 lasers installations shall have a means of preventing unauthorized operation (such as a key which is removed and secured when the laser is not in use). Administrative controls or room door locks may also suffice. The means shall be specified clearly in the SOP document.

8. *Emergency Cutoff Switch*

All class 4 lasers shall be equipped with an easy-to-operate device to cut off the beam or reduce the power level below the MPE. The device shall be clearly labeled with the "Emergency Laser Shutdown" label supplied by ESH.

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## Appendix A

### Some generally applicable laser safety practices

Some generally applicable laser safety practices are outline below.

1. *Dial 911 in an Emergency.*

In any emergency, Dial 911. An emergency is defined as any time you are not in control of a situation. Dialing 911 automatically alerts all the people that need to respond to an emergency.

In any emergency or unusual situation, the rule of thumb is to act conservatively, and protect personnel and equipment as much as possible. Action can be taken only if it is safe to do so. If a situation is out of your control, dial 911.

2. *Plan Ahead.*

Although this practice applies to all phases of laser use, it is particularly applicable during creation of an LCA. Because Laboratory and Division approvals are required before initial start-up of all class 3a, 3b and 4 lasers, consultation with the ANL-LSO and the ESH/QA Coordinator should be sought early in the planning stages to minimize delays in the start-up of such equipment. Significant expense and a substantial lead time (often three months or more) are encountered in acquisition and installation of laser hazard warning lights, entry door interlocks, window coverings, and other materials need to convert laboratory space into a LCA.

3. *Working Alone Policy*

Users should not work alone in a LCA. See Chapter 1-6 of the ANL ESH/QA Manual.

4. *Be Aware of Hazards and Make Others Aware of Hazards*

Supervisors, users and scientific collaborators shall be aware of potential hazards and the laser system engineering and administrative controls prior to the start of work in any LCA. The LCA supervisor shall ensure that all users and in some cases, scientific collaborators have been properly training, completed eye examinations as necessary, and are aware of this information.

5. *Wear Appropriate Protective Eyewear*

Appropriate laser protective eyewear shall be worn whenever operating conditions may result in a potential eye hazards. No one should look directly into a laser beam, even while wearing laser safety eyewear. The LCA supervisor shall ensure that all eyewear is appropriately labeled and stored in a clearly marked and easily accessible.

6. *Minimize Reflections*  
The potential for unwanted specular reflections of the laser beam may be minimized by the removal or covering of all unneeded shiny surfaces near the beam. This includes tools, shiny hand and arm jewelry, glass surfaces, and polished metal surfaces. Specular reflections of infrared laser beams can be produced by surfaces that appear dull to the eye. Remove all jewelry including your wrist watch.
  
7. *Shield Sources of Reflections*  
Necessary sources of specular reflection, such as lenses and cells, shall be properly shielded from view or enclosed.
  
8. *Enclose Beam and Target*  
Most lasers and laser systems operating in CHM are high-powered (class 4 lasers). Class 4 lasers can, by definition, produce hazardous diffuse reflections. Partial or total enclosure of the beam and target are necessary for most class 4 laser installations. Extreme caution shall be exercised if it is necessary to work with an exposed class 4 beam.
  
9. *Use Noncombustible Beamstops*  
Beam enclosures and beamstops for class 4 lasers shall not be made of combustible material.
  
10. *Use Low-Toxicity Beamstops*  
Class 4 lasers can vaporize portions of targets or beamstops. Make targets or beamstops of materials of low toxicity. Also provide adequate local exhaust ventilation to prevent such airborne contamination from being dispersed into the user's breathing area.
  
11. *Be Familiar with the ANL ESH/QA Policies and Procedures*  
Since other hazards may exist along with laser hazards and appropriate precautions shall be taken. Some particularly pertinent chapters of the ANL/ESH/QA Manual are listed below:  

Chapter 4-3	Chemical and Laboratory Safety
Chapter 4-5	Chemical Carcinogens
Chapter 4-7	Alkali Metal Safety
Chapter 4-8	Hydrogen Safety
Chapter 4-10	Cryogenic Safety
Chapter 6-2	Laser Safety
Chapter 7-6	Noise Control and Hearing Conservation
Chapter 7-9	Housekeeping and Sanitation

LCA supervisors, users, and scientific collaborators should be familiar with all the material in the ANL ESH/QA Manual, and the CHM [Chemical Hygiene](#)

[Plan](#). Knowledge of chapter contents pertinent to laser work and the appropriate work environment is mandatory.

12. *Properly Dispose of Hazardous Waste*

Generators of hazardous waste, such as spent organic solvents, have the primary responsibility for the waste they produce. This responsibility extends to properly documenting the accumulation of such material in the satellite waste accumulation area (SWAA), as well as initiating the proper periodic disposal of accumulated waste. See the Waste Handling Procedures - ANL manual for information concerning the handling and proper disposal of hazardous gaseous, liquid, and solid wastes. Contact your supervisor prior to beginning work with hazardous materials, and the CHM Building Operations Manager for waste handling guidance (200/L179).

## **Laser Safety Books in the Building 200 Library**

The following laser safety standards, laser hazard control and laser safety training aids are available in the Building 200 Library. Take the time to review the material provided in these documents.

*Laser Safety Guide* and *Guide for Selection of Laser Eye Protection*,  
publications of the Laser Institute of America.

*Safety with Lasers and Other Optical Sources, A Comprehensive Handbook*,  
David Sliney & Myron Wolbarsht, authors

The following are available in the reference section of the 200 library

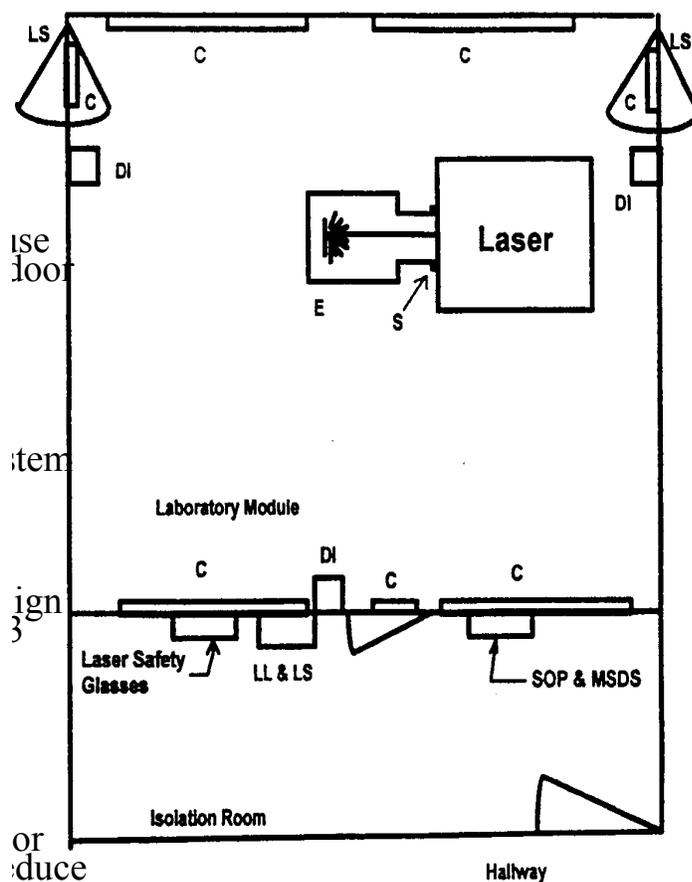
*American National Standard for the Safe Use of Lasers*,  
Z136.10 - 2000, American National Standards Institute.

*Safe Use of Lasers in Educational Institutions*  
Z136.5, American National Standards Institute.

### Appendix C

#### Diagram of Chemistry Division Standard Laser Controlled Area

Diagram of Building 200 Laboratory module converted into a laser controlled area.



## **Appendix D**

### **Chemistry Division Laser Safety Committee**

The current staff serving on the Laser Safety Committee can be found at on the Chemistry Divisions Web Site [here](#).

Appendix E

Laser Control Area Audit form page 1

**CHM Laser Control Area Audit**

LCA:  LCA Supervisor:

IHD	Manufacturer	Model	Type	Serial#	Property#	Class	Disposal Code
<input type="text"/>							

**CERTIFIED LASER OPERATOR CHECKLIST** Verify all operators listed in SOP for this LCA are qualified.

	Current with Laser Safety ESH120?	Current with CFR ESH109?	Operators were given specialized hands-on training?	Baseline eye exam
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**OPERATION CHECKLIST** (Indicate either Y/N in each box provided. Indicate N/A for Not Applicable.)

Posted at entry to lab:  Current SOP?  Eyewear handling, accessibility & location of storage is proper.

**Type of Entry Control:**  Limited LCA access,  under Administrative or,  Engineering controls.

Interlock system inspected at all possible entrances.  Interlock system inspection record reviewed?

Laser safety eyewear inspected.  Eyewear inspection record reviewed and in compliance.

Concurrent laser experiments in same LCA properly isolated from one another (curtains, beam blocks, etc.).

**Class 4 Lasers:**  Emergency Cut-off Switch in place.  Non-normal operation control in place

**Invisible Lasers:**  On indicator and audible or visual from all work locations.

Alignment procedure walk-through.  Grounding strap present on dye lasers.

Precautions/shielding to prevent stray laser beams from exiting LCA through open doors, or windows.

Proper storage/handling of laser gases, dyes, and solvents reviewed and in compliance.

Satellite Waste Accumulation Area designated.  Record/Log reviewed and in compliance.

Beam path enclosures include no hazardous unenclosed eye-level or vertical beams present.

When working "hot" (exposed high voltage) during laser maintenance, is a safety watch available?

Is an approved SOP up-to-date?  SOP reviewed and hazard controls addressed where appropriate.

Provide comments, exceptions, corrective actions needed, & signatures of Inspection Team on back.

page 2

**Laser Control Area Audit**   Pg. 2  
LCA LCA Supervisor

**Comments & Exceptions** Also list any additional Operators not listed on the front here.

**Previous Comments/Corrective Actions**

**Corrective Action Items**

All Requirements Satisfied for Laser Operation?  Temporary Approval Expiring  Date

Approved by: \_\_\_\_\_ Date \_\_\_\_\_  
 ANL-E Laser Safety Officer  Deputy Laser Safety Officer



**INTRODUCTION**

Indicate in a paragraph the physical location of this LCA, include the building, room, etc. Provide a brief description of the overall mode of operation of this LCA, indicating the total number of active lasers. If diagrams or floor plans are available for this LCA, the descriptions should be noted here, and included as Appendix A at the end of this document.

**LCA SUPERVISOR**

Indicate the LCA supervisor, including their badge number and how to contact him/her (i.e., phone extension and email address if available).

**AUTHORIZED USERS**

While an important part of your SOP, this list of all Authorized Users, including their badge number, should appear as Appendix C of this document and users should sign the document to verify that they have read and understand the Standard Operating Procedure for the LCA. Appendix C can be updated as frequently as needed.

**SCIENTIFIC COLLABORATORS & VISITORS**

Define other types of persons who will or may need access to the LCA, and their responsibilities. You can use the definitions and responsibilities that start on page 9 of the Laser Safety Manual as a starting point. More restrictive responsibilities are at your discretion.

Define what a Scientific Collaborator, spectator, and non participating visitor are and under what conditions will they be allowed in your LCA. A collaborator is a scientific or technical visitor who handles some other (non-laser) part of the experiment. Define under which circumstances they are allowed in and what they will do, what eyewear they must have etc. You may also wish to define general responsibilities for field service engineers, although the specific tasks will be controlled by a Job Safety Analysis.

You may also wish to address the entry of maintenance and custodial people into the LCA.

**NORMAL LASER OPERATION**

Indicate the General Setup of your LCA. This should provide a detailed description of what the essential system consists of; how it is set-up on the tables; how the output is directed; where the optical components are located; how the beam is terminated; where the emergency stop is located, if applicable; how and where the beam is enclosed, or unenclosed; and the height of the beam. Unenclosed beams have to be fully justified by the needs or nature of the experiment.

List each laser in use in your LCA: 1) Indicate the Industrial Hygiene Identification Number (IHID); 2) Indicate the ANL Property #; 3) Indicate the serial number; 4)

Indicate the class of the laser; 5) Indicate the type of eyewear appropriate for that laser. For each laser, provide a brief paragraph describing the essential technical specifications, such as wavelength(s), power, repetition rate, beam shape and dimensions, divergence, O.D. of eyewear needed for protection from a direct hit. An example follows:

**Example:*****Lambda Physik COMPex 102 Excimer Laser***

IHID	Property #	Serial #	Class	Eyewear
02346	P065553	9512E4280	4	O.D. 7

This laser is capable of pulsed operation up to 20 Hz and can emit a variety of UV wavelengths that depend on the excimer gas, as listed below:

Gas:	F <sub>2</sub>	ArF	KrF	XeCl	ZeF
Wavelength (nm):	157	193	248	308	351
Pulse energy (mJ):	10	200	350	200	150

The laser is currently optimized for fluorine operation, and thus its use with XeCl is not recommended at this time. The main purpose of this laser is to photodissociate the sample molecular beam, although it can be used to pump one of the dye lasers (IHID# 1234 and #44443 above).

**EYEWEAR SECTION**

This section contains the calculation or specification for the calculation of O.D. for eyewear appropriate to your operating conditions. If several types of eyewear are normally used in the LCA, indicate the different types and the laser for which they are needed. If there is a simple solution for eyewear (such as eyewear X is always worn when laser Y is on) list it here. However, if it is complex consider providing the information in a table or graph form, (as Appendix B to this document) indicating the types of eyewear appropriate to the lasers used in this LCA. The supervisor should consider posting such a graph or chart in the lab. Also, indicate spectator and collaborator eyewear here, if different than that of the operator.

Note that eyewear shall be physically inspected at least annually for damage or deterioration. Indicate your testing procedure including intervals and your procedures for logging of this practice.

**LASER MODIFICATION HAZARD CONTROL**

A modification of a laser system is defined as any time optics are removed or added, or the beam path is radically altered from the condition when it was approved by the LSO. This does not include alignment procedures, which are discussed in the next section, although the two are related. In some cases, modifications that alter the beam path through different optical components may be routine depending on the type of experiment. The distinction between routine and non routine modifications should be made clear. Describe the procedures that will be used and who can carry out the procedures related to modification of laser systems. Describe the nature and limits of the modifications and what safety protocols must be observed. For all types of modifications list the changes in set-up that may occur. Provide a detailed description of changes that are made to shielding, housing etc., to access the beam. Include such information as the state of the laser when doing modifications, and who may have authority to modify what optical components. Also, indicate how the coordination between the LCA supervisor and the LCA users working on the modification or using the LCA will be accomplished. A statement should also be included to indicate at what level of modification the LSO will be consulted.

#### **ALIGNMENT HAZARD CONTROL**

Indicate the General Setup for the alignment procedure of your LCA. Describe internal (manufacturer procedures can be deferred to the respective laser manuals) and external alignments of the beams separately. If possible, break down this information according to each laser.

Describe in adequate detail alignment procedures, how is alignment done, and what is monitored/viewed to optimize alignment etc. Indicate what type of eyewear is used if different than normal, and give a calculation supporting a lower O.D. Include spectator and collaborator policy during this procedure here.

Indicate all other non-routine work here. Include a statement that work outside the current SOP requires a Division review.

#### ***Example:***

***Laser 02346 - Lambda Physik COMPex 102 Excimer Laser*** This laser is factory aligned and generally does not require any addition internal adjustments. Routine minor adjustments are to be performed at the lowest power feasible and in complete accord with the manufacturer's maintenance manual.

#### **LASER HAZARD CONTROL**

1. *Door Interlocks:* Describe in detail all the interlock systems used to control entry to the LCA. Indicate your testing procedure, including intervals, and how you

- document this practice. Note that interlocks must be tested at least quarterly for proper operation.
2. *Window/Door Covers*: Describe all covers and materials used for control. Indicate your testing procedure including intervals and your procedures for logging of this practice.
  3. *Warning Signs*: Describe all signs posted, especially at the entrance for control. Indicate your testing procedure including intervals and your procedures for logging of this practice.
  4. *Unauthorized Operation (Class 4)*: Describe the methods used in the LCA to prevent unauthorized operation (e.g., lab is locked when nobody is in, and/or laser keys removed, etc.)
  5. *Invisible Laser Beam "ON" Indicator*: Describe the methods used in the LCA to indicate that invisible beams are on.
  6. *Emergency Cut-off Switch (Class 4)*: Describe the panic switch operation and location in the LCA.

Provide some general discussion regarding the type of activities that are permitted when the laser is on under normal conditions. Discuss proper training, adequate care, and laboratory practices. Include the additional use of computers and monitors and the positioning and/or shielding of these items. Note in this area the additional hazard controls used for chemicals, high voltage, hot plates, glassware, cryogenic fluids, other equipment.

### CONTROL OF ADDITIONAL LCA HAZARDS

Indicate other possible hazards associated with the lasers in your LCA.

#### **Example :**

Some of the lasers listed above pose additional hazards over and above those associated with the laser light output. These include:

**Laser 02346 - Lambda Physik COMPex 102 Excimer Laser** The high voltage circuitry associated with this laser is contained within the laser cabinet, and cannot be accessed except by removing the cover (as performed during maintenance and repair). An interlock switch on the cabinet prevents the high voltage circuits from charging when the cover is opened, except when this switch is deliberately defeated.

Compressed gases are used to generate the lasing medium for this laser. Compressed He, Ne, Ar, Kr, Xe, 5% HCl - 1% H<sub>2</sub> in He, and other necessary gases or mixtures are contained either in full-size or reduced-size standard high pressure tanks fitted with appropriate regulators. Typically, the tanks are located in the dedicated space along the east wall. At all times the tanks are rigidly secured using standard straps and/or chains. When appropriate from the safety viewpoint, the smaller size cylinders can be located in the adjacent hood. All corrosive gases are fed into the laser inlet using tubing made of compatible materials. In particular, tubing used for mixtures containing elevated concentrations of F<sub>2</sub> has to be properly passivated prior to routine use.

**ASSOCIATED CHEMICAL HAZARD CONTROL**

List chemicals used in this LCA include a list MSDS numbers, or attach MSDS's to the end of the document (not required to attach MSDS sheets). If you prefer, provide the chemical list section from your Project Review Document as an Appendix. Indicate in this section if there is a registered Satellite Waste Accumulation Area in the LCA and where it is located. Discuss any site-specific chemical hazards for this LCA in this section.

**CONTROL OF EMERGENCIES & ABNORMAL SITUATIONS**

Describe some of the general emergencies (fire, explosion, personal injury, etc.) that are possible with the site specific hazards in the laboratory. This section provides some guidance for other extraordinary situations that may require immediate action in order to avoid the possibility of personal injury or equipment damage.

In any emergency or unusual situation, the main rule of thumb is to act conservatively, and protect personnel and equipment as much as possible. Action can be taken only if it is safe to do so. If a situation is out of your control, get help by dialing 911.

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**APPENDIX A  
FLOOR PLAN DIAGRAM**

If diagrams or floor plans are available for this LCA, the descriptions should be noted and included.

**APPENDIX B  
EYEWEAR SECTION**

Shall contain the calculation of O.D. for eyewear. A chart or graph indicating the types of eyewear appropriate to the lasers used in this LCA.

**APPENDIX C  
AUTHORIZED USERS**

List all Authorized Users, include their badge number. Users should sign the document to verify that they have read and understand the Standard Operating Procedure for the LCA.

NAME (printed)	BADGE	SIGNATURE