UCDAVIS

ELECTRICAL & COMPUTER ENGINEERING

INJURY AND ILLNESS PREVENTION PROGRAM

UC DAVIS

ELECTRICAL & COMPUTER ENGINEERING

INJURY AND ILLNESS PREVENTION PROGRAM

This Injury and Illness Prevention Program has been prepared by the University of California, Electrical & Computer Engineering department in accordance with University Policy (UCD Policy & Procedure Manual Section 290-15: Safety Management Program) and California Code of Regulations Title 8, Section 3203 (8 CCR, Section 3203).

UC DAVIS

ELECTRICAL & COMPUTER ENGINEERING

INJURY AND ILLNESS PREVENTION PROGRAM

TABLE OF CONTENTS

APPENDICES

Department Information

Department Name: **Electrical & Computer Engineering**

Department Chair: **Prof. Bahram Ravani**

Address: **2064 Kemper Hall**

Telephone Number: **752-2455**

Buildings Occupied by Department

1. **Building:** **Kemper Hall**

   Unit(s): **088,121,122, 125, 127, 131,154, 1101, 1105, 1107, 1127, 1207, 1209,1217, 2001, 2003, 2031,2035, 2037, 2038, 2039, 2040, 2041, 2064, 2064A, 2064B, 2064C, 2064D, 2064E2101, 2104, 2107, 2110, 2112, 2113, 2115, 2117, 2119, 2147, 2151, 2152, 2154, 2155, 2156, 2157, 2158, 2161, 2201, 2201A, 2206, 2211, 2212, 2219, 2221, 2225, 2227, 2229, 2230,3007, 3087, 3089, 3101, 3103, 3112, 3114, 3116, 3117, 3118, 3119, 3120, 3122, 3123, 3124, 3125, 3127, 3129, 3131, 3135, 3137, 3139, 3141, 3145, 3148, 3161A, 3161B, 3163, 3165, 3167, 3169, 3171, 3173, 3174, 3174A, 3175, 3176, 3176A, 3177, 3179, 3181, 3182, 3183, 3185, 3187, 3189, 3193**

   Contact: **Lance Halsted (Safety Coordinator) / Linda Potoski (MSO)**
   Phone: **752-8959 / 752-9548**

2. **Building:** **TB207**

   Unit(s): **TB-114, TB-115, TB-117, TB-119, TB-121, TB-123, TB-125, TB-127, TB-129, TB-131, TB-133**

   Contact: **Lance Halsted (Safety Coordinator) / Linda Potoski (MSO)**
   Phone: **752-8959 / 752-9548**

3. **Building:** **Academic Surge**

   Unit(s): **2346**

   Contact: **Lance Halsted (Safety Coordinator) / Linda Potoski (MSO)**
   Phone: **752-8959 / 752-9548**

I. Authorities and Responsible Parties

The authority and responsibility for the implementation and maintenance of the Injury and Illness Prevention Program (IIPP) is in accordance with University Policy (UCD Policy & Procedure Manual Section 290-15: Safety Management Program) and California Code of Regulations (8 CCR, Section 3203) and is held by the following individuals:

1. Name: **Prof. Bahram Ravani**

   Title: **Interim Department Chair**

   Authority: Authority and responsibility for ensuring implementation of this IIPP

   Signature: ***ON FILE IN DEPARTMENT*** Date: ____________________

2. Name: **Lance Halsted**

   Title: **Safety Coordinator**

   Authority: Direct authority and responsibility for implementing and maintaining this IIPP

   Signature: ***ON FILE IN DEPARTMENT*** Date: ____________________

3. Name: **Linda Potoski**

   Title: **MSO**

   Authority: Direct authority and responsibility for implementing and maintaining this IIPP

   Signature: ***ON FILE IN DEPARTMENT*** Date: ____________________

ECE Safety Committee

The Electrical & Computer Engineering department has established a safety committee, consisting of faculty and staff members, to maintain the safety program of the department. This committee supports the role of the Department Safety Coordinator. Communication on safety issues within the department is enhanced by committee participation of both faculty and staff.

Duties of the ECE Safety Committee

The safety committee has the following duties and responsibilities:

1. Coordinate activities of department/unit safety coordinators, provide direction, and facilitate the dissemination of safety information.

2. Meet at least quarterly.

3. Review results of inspections conducted by the department safety coordinators and audits or inspections by groups outside of the department/unit, e.g., EH&S inspections, Department of Health Services inspections.

4. Review investigations of accidents and cases of injury and illness, and make recommendations regarding prevention.

5. Develop strategies for implementing new safety management programs.

6. Develop standardized procedures to make sure all students and staff using any of the labs are properly trained related to safety.

7. Submit recommendations in response to employee safety suggestions.

8. Coordinate department safety issues with the college and the campus.

9. Appoint ad hoc committees as required.

10. Keep written records of meetings and make them available to department/unit employees

II. System of Communications

1. Effective communications with **Electrical & Computer Engineering** employees have been established using the following methods:

- [ ] Standard Operating Procedures Manual
- [x] Material Safety Data Sheets
- [ ] Monthly departmental operations meetings
- [ ] Internal media (department intranet)
- [x] EH&S Safety Nets
- [ ] Training videos
- [ ] Safety Newsletter
- [x] Handouts
- [x] Building Evacuation Plan
- [x] E-mail
- [x] Posters and warning labels
- [x] Job Safety Analysis – Initial Hire
- [ ] Job Safety Analysis – Annual Review
- [x] Other (list):

ECE Department Safety web page linked to ECE Dept. homepage.

2. Employees are encouraged to report any potential health and safety hazard that may exist in the workplace. **Hazard Alert Forms (Appendix A)** are available to employees for this purpose. Forms are to be placed in the Safety Coordinator's departmental mail box. Employees have the option to remain anonymous when making a report.

3. Employees have been advised of adherence to safe work practices and the proper use of required personal protective equipment. Conformance will be reinforced by discipline for non-compliance in accordance with University policy (UCD Procedure 62 - Personnel Policies for Staff Members, Corrective Action).

III. System for Assuring Employee Compliance with Safe Work Practices

Employees have been advised of adherence to safe work practices and the proper use of required personal protective equipment. Conformance will be reinforced by discipline for non-compliance in accordance with University policy (UCD Procedure 62 - Personnel Policies for Staff Members, Corrective Action).

The following methods are used to reinforce conformance with this program:

1. Distribution of Policies

2. Training Programs

3. Safety Performance Evaluations

   Performance evaluations at all levels include an assessment of the individual's commitment to and performance of the accident prevention requirements of his/her position. The following are examples of factors considered when evaluating an employee's safety performance.

   - Adherence to defined safety practices.
   - Use of provided safety equipment.
   - Reporting unsafe acts, conditions, and equipment.
   - Offering suggestions for solutions to safety problems.
   - Planning work to include checking safety of equipment and procedures before starting.
   - Early reporting of illness or injury that may arise as a result of the job.
   - Providing support to safety programs.

4. Statement of non-compliance will be placed in performance evaluations if employee neglects to follow proper safety procedures, and documented records are on file that clearly indicate training was provided for the specific topic, and that the employee understood the training and potential hazards.

5. Corrective action for non-compliance will take place when documentation exists that proper training was provided, the employee understood the training, and the employee knowingly neglected to follow proper safety procedures. Corrective action includes, but is not limited to, the following: Letter of Warning, Suspension, or Dismissal.

IV. Hazard Identification, Evaluation, and Inspection

Job Hazard Analyses and worksite inspections have been established to identify and evaluate occupational safety and health hazards.

1. Job Safety Analysis:

Job Safety Analysis (JSA) identifies and evaluates individual employee work functions, potential health or injury hazards, and specifies appropriate safe practices, personal protective equipment, and tools/equipment. JSA's have been completed for the following job categories:

A. **Kemper Hall, TB207/ faculty and staff offices**
Kemper Hall 131, 2211, 2219, 2221, 2225, 2227, 2229, 2230, 3148, 3174, 3174A
Kemper Hall 1101, 1105, 2107, 2110, 2112, 2155, 2157, 2161, 3189, 3193
Academic Surge/ 2346
- General office environment

B. **Kemper Hall 125, 127, 154, 1207, 1209, 2212**
- Chemical hazards
- Physical hazards (lasers, compressed gas)
- General office environment

C. **Kemper Hall 3176, 3176A**
- Chemical hazards
- General office environment

D. **Kemper Hall 1217**
- Chemical hazards
- Radioactive hazards
- Physical hazards (compressed gas)
- General office environment

E. **Kemper Hall 121, 122, 1107, 3182**
- Physical hazards (lasers, compressed gas, microwave-producing equipment)
- General office environment

F. **Kemper Hall 2147, 2151, 2201, 2201A**
- Tool hazards (drill, soldering iron, drill press, Exacto knife, Dremel tool, etc.)
- General office environment

Job Safety Analysis Forms are located in **Appendix B. <u>Completed</u> Job Safety Analyses are to be signed by each employee and kept on file in Kemper Hall 2064 or 2152**.

Before a person (whether an employee or not) will be given access to a research lab with safety hazards, the individual must meet with the Department Safety Coordinator to discuss what safety training will be required and when it will have to be completed. The Department Safety Coordinator, if so needed in consultation with faculty responsible for the lab, will determine the required safety training consistent with the Job Safety Analysis for that research lab. Once the safety training is completed, documentation for record keeping must be filed with the Department Safety Coordinator.

2. Undergraduate Lab Course Safety Analysis

Lab Safety training will be completed for all undergraduate lab courses that have any potential health or injury hazards before the lab is used. Lab courses that have been identified as having potential safety hazards are required to provide training to the students in appropriate safe practices, personal protective equipment, and tools/equipment. The following courses have been identified as having potential safety hazards for which the students must be trained:

A. EEC132
- Chemical hazards

B. EEC136
- Laser hazards

C. EEC194 (Micromouse)
- Power and hand-tool hazards, drill press

D. EEC195 (Natcar)
- Power and hand-tool hazards, drill press

The Department Safety Coordinator, along with the course instructor, will coordinate safety training for the students before giving them access to lab facilities or equipment with safety hazards. Students must attend the required safety training session and documentation must be kept verifying each student's successful completion of the required training. Example safety training information for EEC132 and EEC136 is included in **Appendix B1 and B2**.

3. Worksite Inspections

Worksite inspections are conducted to identify and evaluate potential hazards. Types of worksite inspections include both periodic scheduled worksite inspections as well as those required for accident investigations, injury and illness cases, and unusual occurrences. Inspections are conducted at the following worksites:

1)	Location:	**Kemper Hall 131, 2211, 2219, 2221, 2225,** **Kemper Hall 2227, 2229, 2230, 3148, 3174, 3174A** **Kemper Hall 1101, 1105, 2107, 2110, 2112, 2155, 2157, 2161** **Kemper Hal/ 125, 127, 1207, 2212** **Kemper Hall 3176, 3176A** **Kemper Hall 1217** **Kemper Hall 121, 122, 1107, 3182** **Kemper Hall 2147, 2151, 2201, 2201A**
	Frequency:	**Annual**
	Responsible Person:	**Lance Halsted**
	Records Location:	**2152 Kemper**

Worksite Inspection Forms are located in **Appendix C**. Completed Worksite Inspection Forms will be kept on file in Kemper Hall 2152**.**

V. Accident Investigation

1. **Electrical & Computer Engineering faculty, staff and student employees** will immediately notify their supervisor when occupationally-related injuries and illnesses occur, or when employees first become aware of such problems. **Electrical & Computer Engineering undergraduate students** will immediately notify their Teaching Assistant in the case of any injury sustained during a lab session.

2. **Supervisors** will investigate all accidents, injuries, occupational illnesses, and near-miss incidents to identify the causal factors or attendant hazards. Appropriate repairs or procedural changes will be implemented promptly to mitigate the hazards implicated in these events. **Teaching Assistants** will immediately report any accidents, injuries, and near-miss incidents to the course instructor and/or the Department safety coordinator.

   The **<u>Accident Investigation Form (Appendix D)</u>** shall be completed to record pertinent information and a copy retained to serve as proper documentation.

3. **Note: Serious occupational injuries, illnesses, or exposures must be reported to Cal/OSHA by an EH&S representative <u>within eight hours</u> after they have become known to the supervisor. These include injuries/illnesses/exposures that cause permanent disfigurement or require hospitalization for a period in excess of 24 hours. Please refer to EH&S SafetyNet #121 for OSHA notification instructions.**

VI. Hazard Correction

Hazards discovered either as a result of a scheduled periodic inspection or during normal operations must be corrected by the **Supervisor** in control of the work area, or by cooperation between the department in control of the work area and the supervisor of the employees working in that area. Supervisors of affected employees are expected to correct unsafe conditions as quickly as possible after discovery of a hazard, based on the severity of the hazard.

Specific procedures that can be used to correct hazards include, but are not limited to, the following:

- Tagging unsafe equipment “Do Not Use Until Repaired,” and providing a list of alternatives for employees to use until the equipment is repaired.

- Stopping unsafe work practices and providing retraining on proper procedures before work resumes.

- Reinforcing and explaining the need for proper personal protective equipment and ensuring its availability.

- Barricading areas that have chemical spills or other hazards and reporting the hazardous conditions to appropriate parties.

Supervisors should use the **Hazard Correction Report (Appendix E)** to document corrective actions, including projected and actual completion dates.

If an imminent hazard exists, work in the area must cease, and the appropriate supervisor must be contacted immediately. If the hazard cannot be immediately corrected without endangering employees or property, all personnel need to leave the area except those qualified and necessary to correct the condition. These qualified individuals will be equipped with necessary safeguards before addressing the situation.

VII. Health and Safety Training

Health and safety training, covering both general work practices and job-specific hazard training is the responsibility of the **Department Safety Coordinator** and **immediate Supervisor(s)** as applicable to the following criteria:

1. Supervisors are provided with training to become familiar with the safety and health hazards to which employees under their immediate direction and control may be exposed.

2. All new employees receive training prior to engaging in responsibilities that pose potential hazard(s).

3. All employees given new job assignments receive training on the hazards of their new responsibilities prior to actually assuming those responsibilities.

4. Training is provided whenever new substances, processes, procedures or equipment (which represent a new hazard) are introduced to the workplace.

5. Whenever the employer is made aware of a new or previously unrecognized hazard, training is provided.

VIII. Recordkeeping and Documentation

Documents related to the IIPP are maintained in the **Electrical & Computer Engineering** main office:

2064 Kemper Hall and/or 2152 Kemper Hall.

The following documents will be maintained within the **IIPP Addendum Binder** for at least the length of time indicated below:

1. Hazard Alert Forms (Appendix A form).
   Retain for three (3) years.

2. Employee Job Safety Analysis forms (Appendix B form)
   Retain for the duration of each individual's employment.

3. Worksite Inspection Forms (Appendix C form).
   Retain for three (3) years.

4. Accident Investigation Forms (Appendix D form).
   Retain for three (3) years.

5. Hazard Correction Reports (Appendix E form).
   Retain for three (3) years.

The following documents will be maintained within the **IIPP Training Records Binder** for at least the length of time indicated below:

1. Employee Safety Training Attendance Records.
   Retain for three (3) years.

IX. Resources

1. Office of the President: University Policy on Environmental Health and Safety, 10/22/86

2. UC Davis Policy and Procedure Manual, Section 290-15, Safety Management Program

3. California Code of Regulations Title 8, Section 3203, (8CCR §3203), Injury and Illness Prevention Program

4. Personnel Policies for Staff Members, Corrective Action, UCD Procedure 62

5. University of California Policy on Management of Health, Safety and the Environment, http://www.ucop.edu/riskmgt/ehs/policy.html

6. UC Davis Environmental Health & Safety

   - EH&S Website
   - EH&S SafetyNets
   - Material Safety Data Sheets

HAZARD ALERT FORM

Department:____

I. Unsafe Condition or Hazard

Name: (optional)________________________ Job:__________________

Title: (optional)____________________________

Location of Hazard:____________________________________

Building:____________________ Floor:____________ Room:__________

Date and time the condition or hazard was observed:

____

Description of unsafe condition or hazard:____________________________

____

____

What changes would you recommend to correct the condition or hazard?

____

____

Employee Signature: (optional)________________________________

Date:____________________

II. Management/Safety Committee Investigation

Name of person investigating unsafe condition or hazard:

____

Results of investigation (What was found? Was condition unsafe or a hazard?): (Attach additional sheets if necessary.)

____

____

____

____

Proposed action to be taken to correct hazard or unsafe condition: (Complete and attach a Hazard Correction Report, IIPP Appendix E)

____

____

____

Signature of Investigating Party:______________________________

Date:____________________

Completed copies of this form should be routed to the appropriate supervisor and department Safety Coordinator, and must be maintained in department files for at least three years.

<table>
<tr><td>EMPLOYEE:</td><td>JOB SAFETY ANALYSIS</td><td>DEPT:
EEC</td><td>LOCATION</td><td>JOB TYPE</td></tr>
<tr><td>JOB FUNCTION</td><td>POTENTIAL HEALTH OR INJURY HAZARDS</td><td colspan="3">SAFE PRACTICE, APPAREL, OR EQUIPMENT</td></tr>
<tr><td rowspan="4">General office environment</td><td>Backstrain, eyestrain, repetitive motion injury.</td><td colspan="3">Ensure that workstations are ergonomically correct.</td></tr>
<tr><td>Physical injuries due to slips, trips and falls, and falling objects.</td><td colspan="3">Keep floors clear of debris and liquid spills. Keep furniture, boxes, etc. from blocking doorways, halls and walking space. Do not stand on chairs of any kind, use proper foot stools or ladders. Do not store heavy objects overhead. Do not topload filing cabinets, fill bottom to top. Do not open more than one file drawer at a time.</td></tr>
<tr><td>Electrical hazards.</td><td colspan="3">Do not use extension cords in lieu of permanent wiring. Ensure that high wattage appliances do not overload circuits. (Plug high wattage appliances directly into wall outlet.) Use GFIs in receptacles in potentially wet areas. Replace frayed or damaged electrical cords. Ensure that electrical cords are not damaged by being wedged against furniture or pinched in doors.</td></tr>
<tr><td>Physical injuries due to fires, earthquakes, bomb threats and workplace violence.</td><td colspan="3">Attend emergency action and fire prevention plan training including emergency escape drills.</td></tr>
<tr><td></td><td></td><td colspan="3">SIGNATURE</td></tr>
<tr><td></td><td></td><td colspan="2">DATE</td><td>PAGE 1 OF 1</td></tr>
</table>

EMPLOYEE:	**JOB SAFETY ANALYSIS**	DEPT: **EEC**	LOCATION:	JOB TYPE:
JOB FUNCTION	POTENTIAL HEALTH OR INJURY HAZARDS	SAFE PRACTICE, APPAREL, OR EQUIPMENT		
Perform research in an environment involving **chemical hazards**.	Exposure to chemicals via inhalation, contact, ingestion or injection.	Avoid all unnecessary exposures. Reduce exposures that cannot be avoided by minimizing exposure duration and concentration. Proper selection and use of personal protective equipment including gloves, protective eyewear, lab coats, and in some instances respiratory protection. Implementation of proper personal hygiene habits, including washing hands and face before eating and smoking. During the first 6 months of employment, personnel will receive basic training in Chemical Laboratory Safety, Hazardous Waste Management and Minimization Training that will be coordinated by the ECE Safety Officer. Training in other applicable safety courses will coordinated by ECE Safety Officer on an individual basis after consultation with faculty advisor.		
		SIGNATURE		
		DATE	PAGE 1 OF 1	

EMPLOYEE:	**JOB SAFETY ANALYSIS**	DEPT: **EEC**	LOCATION:	JOB TYPE:
JOB FUNCTION	POTENTIAL HEALTH OR INJURY HAZARDS	SAFE PRACTICE, APPAREL, OR EQUIPMENT		
Perform research in an environment containing **physical hazards**.	Injury from physical hazards including high voltage, **lasers** and ultraviolet light, **microwaves**, **compressed gases** and liquids, cryogenic materials, and specialized equipment as well as falling objects.	Avoid unnecessary exposures. Proper selection and use of personal protective equipment including gloves, protective eyewear and specialized equipment. Employees are not to enter restricted areas unless accompanied by a properly trained individual familiar with the hazards of the area. Personnel are not to operate specialized equipment without proper training and documentation. Watch for overhead hazards and wear head protection if needed. During the first 6 months of employment, personnel routinely entering areas where lasers are used will receive laser safety training that will be coordinated by the ECE Safety Officer. Training in other applicable safety courses will coordinated by ECE Safety Officer on an individual basis after consultation with faculty advisor.		
		SIGNATURE		
		DATE	PAGE 1 OF 1	

EMPLOYEE:	**JOB SAFETY ANALYSIS**	DEPT: **EEC**	LOCATION:	JOB TYPE:
JOB FUNCTION	POTENTIAL HEALTH OR INJURY HAZARDS	SAFE PRACTICE, APPAREL, OR EQUIPMENT		
Perform research in an environment involving **radiological materials**.	Exposure to radiological agents via inhalation, contact, ingestion or injection.	Avoid all unnecessary exposures. Adhere to radiological material handling procedures including limiting exposures through combination of minimizing time, maximizing distances and use of appropriate shielding. Proper selection and use of personal protective equipment including gloves, protective eyewear, lab coats, and in some instances respiratory protection Implementation of proper personal hygiene habits, including washing hands and face before eating and smoking. During the first 6 months of employment, personnel will receive basic training in Radiation Safety that will be coordinated by the ECE Safety Officer. Training in other applicable safety courses will coordinated by ECE Safety Office on an individual basis after consultation with faculty advisor.		
		SIGNATURE		
		DATE	PAGE 1 OF 1	

<table>
<tr><td>EMPLOYEE:</td><td>JOB SAFETY ANALYSIS</td><td>DEPT:
EEC</td><td>LOCATION:</td><td>JOB TYPE:</td></tr>
<tr><td>JOB FUNCTION</td><td>POTENTIAL HEALTH OR INJURY HAZARDS</td><td colspan="3">SAFE PRACTICE, APPAREL, OR EQUIPMENT</td></tr>
<tr><td>Perform research in an environment containing power- or hand- tool hazards.</td><td>Injury from tools or equipment including hand drill, drill-press, exacto knives, soldering iron, Dremel tool, or other hand tool .</td><td colspan="3">Personnel are not to operate specialized equipment, such as a drill press, without proper training and documentation. Use personal protective equipment including gloves, protective eyewear and specialized equipment. During the first 6 months of employment, personnel will receive safety training that will be coordinated by the Lab Supervisor and the ECE Safety Officer.</td></tr>
<tr><td></td><td></td><td colspan="3">SIGNATURE</td></tr>
<tr><td></td><td></td><td colspan="2">DATE</td><td>PAGE 1 OF 1</td></tr>
</table>

WORKSITE INSPECTION FORM

General Office Environment

Location: ______________________ Date: ______________________

Inspector: ______________________ Phone: ______________________

Department: ______________________

Administration and Training

Yes ☐	No ☐	NA ☐	1.	Are all safety records maintained in a centralized file for easy access? Are they current?
Yes ☐	No ☐	NA ☐	2.	Have all employees attended Injury & Illness Prevention Program training? If not, what percentage has attended? ________________
Yes ☐	No ☐	NA ☐	3.	Does the department have a completed Emergency Action Plan? Are employees being trained on its contents?
Yes ☐	No ☐	NA ☐	4.	Are chemical products used in the office being purchased in small quantities? Are Material Safety Data Sheets needed?
Yes ☐	No ☐	NA ☐	5.	Are the Cal/OSHA information poster, Workers' Compensation bulletin, annual accident summary posted?
Yes ☐	No ☐	NA ☐	6.	Are annual workplace inspections performed and documented?

General Safety

Yes ☐	No ☐	NA ☐	7.	Are exits, fire alarms, pullboxes clearly marked and unobstructed?
Yes ☐	No ☐	NA ☐	8.	Are aisles and corridors unobstructed to allow unimpeded evacuations?
Yes ☐	No ☐	NA ☐	9.	Is a clearly identified, unobstructed, charged, currently inspected and tagged, wall-mounted fire extinguisher available as required by the Fire Department?
Yes ☐	No ☐	NA ☐	10.	Are ergonomic issues being addressed for employees using computers or at risk of repetitive motion injuries?
Yes ☐	No ☐	NA ☐	11.	Is a fully stocked first-aid kit available? Is the location known to all employees in the area?
Yes ☐	No ☐	NA ☐	12.	Are cabinets, shelves, and furniture over five feet tall secured to prevent toppling during earthquakes?
Yes ☐	No ☐	NA ☐	13.	Are books and heavy items and equipment stored on low shelves and secured to prevent them from falling on people during earthquakes?
Yes ☐	No ☐	NA ☐	14.	Is the office kept clean of trash and recyclables promptly removed?

Electrical Safety

Yes ☐	No ☐	NA ☐	15.	Are plugs, cords, electrical panels, and receptacles in good condition? No exposed conductors or broken insulation?
Yes ☐	No ☐	NA ☐	16.	Are circuit breaker panels accessible and labeled?
Yes ☐	No ☐	NA ☐	17.	Are surge protectors being used? If so, they must be equipped with an automatic circuit breaker, have cords no longer than 6 feet in length, and be plugged directly into a wall outlet.
Yes ☐	No ☐	NA ☐	18.	Is lighting adequate throughout the work environment?
Yes ☐	No ☐	NA ☐	19.	Are extension cords being used correctly? They must not run through walls, doors, ceiling, or present a trip hazard.
Yes ☐	No ☐	NA ☐	20.	Are portable electric heaters being used? If so, they must be UL listed, plugged directly into a wall outlet, and located away from combustible materials.

Completed copies of this form should be routed to the department Safety Coordinator and must be maintained in department files for at least three years.

WORKSITE INSPECTION FORM

Laboratory Environment

Location: ______________________ Date: ______________________

Inspector: ______________________ Phone: ______________________

Department: ______________________

General Hazards

Yes ☐ No ☐ NA ☐	1.	Are aisles, exits, and adjoining hallways maintained free of obstructions that would hinder emergency access or exiting?
Yes ☐ No ☐ NA ☐	2.	Are there at least 18 inches (47 cm) of vertical clearance between all stored items and the ceiling-mounted fire sprinklers? (If there are no sprinklers, measure to the ceiling itself.)
Yes ☐ No ☐ NA ☐	3.	Are approved sharps waste containers available for disposal of needles, blades, and other sharps? (Reminder: There should be a proper procedure for disposal of broken glass.)
Yes ☐ No ☐ NA ☐	4.	Has furniture and equipment over five feet tall been bolted to the wall or otherwise secured?

Emergency Equipment

Yes ☐ No ☐ NA ☐	5.	Are all emergency eyewash and shower stations free of obstructions that would prevent quick access by someone temporarily blinded by a chemical splash? Are they within 100 feet of the laboratory (or approximately 10 seconds)?
Yes ☐ No ☐ NA ☐	6.	Are the emergency eyewashes for the laboratory tested (flushed) monthly and are the tests documented?

Laboratory Equipment

Yes ☐ No ☐ NA ☐	7.	Look inside each refrigerator and freezer in your lab to ensure flammables are stored in units that are suitable for storage of flammables. Is each refrigerator and freezer in the laboratory labeled as either “safe” or “unsafe” for storage of flammables?
Yes ☐ No ☐ NA ☐	8.	Look inside each refrigerator and freezer in your lab to ensure food is stored only in units designated “food only.” Are all refrigerators, freezers, and microwave ovens properly labeled either “Food Only” or “No Food or Drink Allowed?”
Yes ☐ No ☐ NA ☐	9.	Are all compressed gas cylinders adequately secured with non-combustible restraints to keep the cylinders from falling? (Bench clamps are not adequate to secure large cylinders. Gas cylinders should be capped when not in use.)

Chemicals

Yes ☐ No ☐ NA	10.	Does the lab have a Chemical Hygiene Plan (CHP)? If yes, is it up to date and has it been reviewed and signed within the past year? If no, all labs that contain chemicals are required to maintain a CHP. Complete a lab specific CHP using the EH&S template (http://ehs.ucdavis.edu/chem/chem_mnl/clsm_apps.cfm).
Yes ☐ No ☐ NA	11.	Has the laboratory's chemical inventory been completed or updated within the last year (or within 30 days of a significant change such as a move to a new location or addition of new chemicals) and entered into the EH&S Chemical Inventory System (CIS)?

Yes	☐	No	☐	NA	☐	12.	Are chemical fume hoods kept uncluttered so that air flows properly (e.g., is storage minimized and are adequate work areas provided)? Can ALL chemical work be done more than six inches into hood? (Note: Chemical fume hood sashes must be in good condition and be used at the proper setting, typically 18 inches from the work surface.)
Yes	☐	No	☐	NA	☐	13.	Are all chemical containers and hazardous waste containers kept closed when not in use?
Yes	☐	No	☐	NA	☐	14.	Are all chemical containers (including squirt bottles and unwanted hazardous materials containers) clearly labeled with their contents and primary hazard(s) and are they in good condition (not corroded or leaking)?
Yes	☐	No	☐	NA	☐	15.	Are corrosives stored below eye level and are incompatible chemicals stored appropriately (e.g., acids separate from bases, oxidizers separate from flammables)?
Yes	☐	No	☐	NA	☐	16.	Is a spill kit available? Is the location known to all employees in the laboratory? Has there been training in the past 12 months?
Yes	☐	No	☐	NA	☐	17.	Are peroxide formers (such as isopropyl ether and diethyl ether) stored away from light and heat and labeled with the date they were opened and the expiration date?

Electrical

Yes	☐	No	☐	NA	☐	18.	Are extension cords used only as temporary wiring (<30 days) and not connected in a series (daisy-chained) with other extension cords or power strips? (Cords must be in good condition with no breaks or exposed wiring.)
Yes	☐	No	☐	NA	☐	19.	Is high voltage equipment clearly labeled, properly guarded, and is its use restricted to trained personnel only?

Ergonomics

Yes	☐	No	☐	NA	☐	20.	Are ergonomic issues being addressed for employees using computers or at risk of repetitive motion injuries?

Other Hazards

1.	
2.	
3.	
4.	
5.	

Comments

Completed copies of this form should be routed to the department Safety Coordinator and must be maintained in department files for at least three years.

ACCIDENT INVESTIGATION FORM

Name of Injured Person: ______________________________ Date of Injury: ____________

Name of Supervisor: ______________________________ Telephone #: ________________

Department: ______________________ Location of Injury: ________________________

Brief Description of Accident:

Nature of Injury (describe all body parts affected):

Was Training Provided?	Yes	☐	No	☐	NA	☐
Were established procedures followed?	Yes	☐	No	☐	NA	☐
Were tools or equipment adequate for task?	Yes	☐	No	☐	NA	☐
Were environmental conditions a factor in the incident?	Yes	☐	No	☐	NA	☐

Elaborate on Responses:

Proposed Corrective Action:

Supervisor: ______________________________ Date of Report: ______________

Signature: ____

IIPP-Appendix D
March 2006

Completed copies of this form should be routed to the department Safety Coordinator and kept in department files for at least three years.

HAZARD CORRECTION REPORT

Department:____

This form should be used in conjunction with the "Hazard Alert Form" (IIPP Appendix A), as appropriate, to track the correction of identified hazards.

All hazards should be corrected as soon as possible, based on the severity of the hazard. If a serious imminent hazard cannot be immediately corrected, evacuate personnel from the area and restrict access until the hazard can be addressed.

Supervisor/Safety Coordinator Name: ________________________ Telephone: ______________

Supervisor/Safety Coordinator Signature: ________________________ Date: ______________

Description and Location of Unsafe Condition	**Date Discovered**	**Required Action and Responsible Party**	**Completion Date**	
			Projected	**Actual**

IIPP–Appendix E
March 2006

Completed copies of this form should be routed to the department Safety Coordinator and kept in department files for at least three years.

APPENDIX A

132 B/C DARKROOM PROCEDURE

EEC 132 B/C DARKROOM PROCEDURE

PLEASE WEAR GLOVES WHEN YOU ARE WORKING WITH CHEMICALS.

PLEASE DO NOT OPEN CUPBOARDS UNDER REGULAR LIGHT.

Outline of Procedure:

Red light only:

● Load film holder

● Develop, fix film

Yellow light:

▽ Coat board with photoresist, develop board.

Film:

● Expose: 20 seconds

● Develop: 2 1/2 to 2 3/4 minutes (pull out and check)

● Fix: 2 minutes

Wash: 1 minute

● = a procedure that must be done under a red light

▽ = a procedure that must be done under a yellow light

Board:

	Clean:	with propanol and steel wool (very lightly)
▽	Coat:	uniformly with KPR resist
▽	Bake:	one hour
▽	Expose:	3 to 3.5 minutes
▽	Develop:	3 to 3.5 minutes
	Rinse:	
	Dry uncoated side	
	Tape back	
	Etch:	10-20 minutes

NOTE: Big boards take longer to etch and are likely to develop irregularities such as ragged edges, pinholes, etc. Keep boards small. Small boards with little surplus to be trimmed give good results predicted by Libra. Big boards that must be trimmed excessively, do not.

● = a procedure that must be done under a red light

▽ = a procedure that must be done under a yellow light

DARKROOM PROCEDURE

PRECAUTIONS

The procedure of photography, developing and fabrication of circuit boards involves the use of **hazardous** chemicals, which have the capacity of causing **temporary or permanent damage to health.** Therefore, it is **MANDATORY** that the following precautions be observed at all times during the process:

(a) Use laboratory coats or aprons at all times
(b) Use gloves at all times when handling chemicals
(c) Use goggles for eye protection

PHOTOGRAPHY

1. ● Under the red light take a 4x5" Kodalith film sheet from the cupboard and load it into the film holder.

The dull or darker emulsion side faces out toward the light source. Replace the remaining film back in its box and put back in cupboard.

(a) Remove the slide from the film holder.
(b) Open the hinged light trap.
(c) Slide the film into the film holder, keeping both edges of the film behind the guide rails. The film must be perfectly flat in the film holder.
(d) Close the hinged light trap.
(e) Replace the slide into the slot on the same side as the film.
(f) Load the film holder into camera, remove the slide and expose the film to the picture of the circuit on the wall for 20-25 seconds at f8 (this is using the fluorescent lights from ceiling. Or, if using approx. f11 with incandescent light source at 8 seconds.

● = a procedure that must be done under a red light
▽ = a procedure that must be done under a yellow light

(g) ● Replace the slide. Be sure you've put the slide in the frontmost slot where it will keep light from the film, and then remove the film holder from the camera.

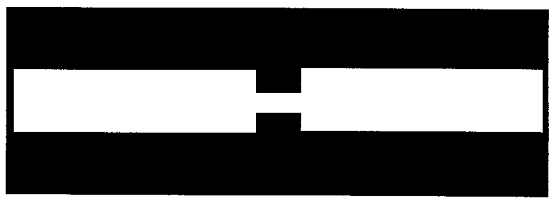
(h) ● Remove the film from the film holder. Submerge the film in A&B solution (developer). Slip the film into the developer at once, emulsion side up so that the entire film is immersed simultaneously.

(i) ● Agitate once every 30 seconds by lifting one end of the developing tank about 1/2" off the counter, and setting it back on the counter. Continue agitating until the 2.5 minute mark (5 agitations total during development).

(j) ● At 2 minutes, 45 seconds, pick up the film from the tank and let drain until the 3 minute mark.

(k) ● Submerge film into photo fixer solution for 2 minutes. Agitate the same way as developer. (The fixer stops development and makes the film no longer light-sensitive).

(l) Take the film out and wash under running water for 1 minute. Hang the film up to dry. The dried film is the mask for your circuit board. Handle it carefully and keep it clean. It should look something like this:



Tongs or forceps may be used to handle the film during development, but for best result, use your fingers. Just be sure to wash your hands after getting them in chemicals!

● = a procedure that must be done under a red light

▽ = a procedure that must be done under a yellow light

FABRICATION OF CIRCUIT BOARD

(a) Cut a minimum size circuit board piece appropriate for your circuit dimensions. You should know the dimensions before you start. Use the cursor in Libra to measure your layout.

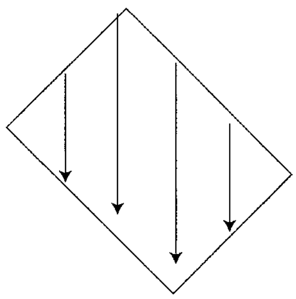
(b) Buff and rub (very lightly) one side of the circuit board piece with fine steel wool (#000).

(c) Use propanol and Kimwipes to take dirt and dust off from the buffed side.

(d) The surface of the circuit must be dust-free and very clean. Handle the cleaned board only by the edges.

(e) ▽ Wearing gloves for this part of the procedure is mandatory under yellow light in the darkroom. Take the bottle of photoresist (KPR) and pour a uniform layer of KPR on your circuit. Don't let your circuit touch anything. Pour a small amount at one edge of the board. Rock the board side-to-side as you let the KPR work its way to the opposite edge, uniformly coating the cleaned side of the board.

(f) ▽ Let the chemical drip off by holding your circuit as the figure below illustrates:



Note: To keep the board from falling while the KPR drains, carefully tape it to the side of the fume hood. Apply a small piece of tape to the backside (non-KPR-coated) of the board, but do NOT let the coated side come into contact with the side of the fume hood. Lean the board against the fume hood, tape the top corner of the board.

▽ = a procedure that must be done under a yellow light

(g) Do not relayer circuit, because relayering the circuit causes a multilayer of KPR photo resist on circuit board that causes uneven etching and non-uniform circuit dimensions. If the coated side falls on anything before it has been baked, use KPR developer as a solvent to remove all of the KPR resist. Clean the board with propanol and steel wool and start again.

(h) ▽ Bake your circuit in the oven for 60 minutes. Replace the oven door lid and leave the lid open about 1" at the bottom.

(i) ▽ Take your circuit out of the oven. Let it cool down. Please be careful as the oven is very hot!

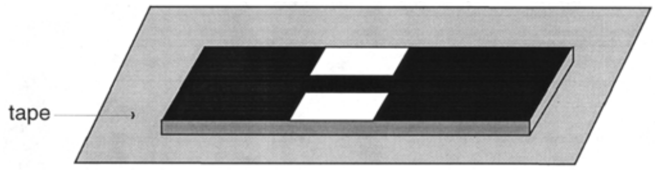
(j) ▽ Lay the film mask on the KPR-coated side of the circuit board. Place the mask, emulsion side down, on the contact printer glass, the board will be on top of the negative. Expose 3 minutes under ultraviolet light. DO NOT LOOK INTO THE ULTRAVIOLET LIGHT DIRECTLY! IT IS HARMFUL TO THE EYES!

(k) ▽ Submerge the circuit into KPR developer for a minimum of 3, maximum 3.5 minutes; agitate once. Replace the cover, keeping the KPR tank in the fume hood. Continue agitating as was done with the film developer.

(l) Remove the board after 3 to 3.5 minutes developing time. Rinse under running water. Dry the board thoroughly. Do not scratch the KPR side. Handle the board by the edges only.

▽= a procedure that must be done under a yellow light

(m) Tape the bottom of the circuit board with paper underneath the tape (minimizing clean up). Make sure that the tape has stuck to the bottom firmly. It must cover the entire bottom of the board. You do not want the etchant to come into contact with the bottom of the board.



(n) Mix determined amount of ammonium peroxidisulfate powder in hot water and keep the solution (etchant) warm by placing the solution in a container on the burner in low heat (11 o'clock). The etching process should be done inside the hood only. Submerge the circuit into the etchant and gently agitate the circuit until the copper etches away.

DO NOT TOUCH THE SURFACE OF THE CIRCUIT!

This should take 25-35 minutes. Do not let the etchant boil. Never set the hotplate thermostat past 12 o'clock. After etching, rinse the circuit with water and remove the masking tape

EEC 136 LASER SAFETY HANDOUT*

The EEC136 labs will use lasers. The dangers associated with the light they generate must be taken very seriously. A split-second exposure to even a small portion of a reflected laser beam is sufficient to cause *permanent loss of vision*. It is important to realize that because of the nature of our work, it is impossible to completely protect oneself from the dangers of accidental exposure to a laser beam. Accidents *have* happened -- accidents can only prevented by 1) being aware of the dangers, and 2) strictly adhering to the rules below.

Background:

If a laser beam strikes your eye, the lens in your eye will focus the light onto your retina, quickly burning a hole in the tissue and permanently damaging the nerves responsible for vision. As you can read in the attached case histories, severe complications, like bleeding, can lead to a complete and permanent loss of vision in an eye. *Absolutely nothing can be done to repair or reverse any retinal damage.*

The lens of the eye transmits light with wavelengths in the *ocular focus* range 0.35-1.4 *u*m. Intense laser light outside the ocular focus range can still cause damage to the surface of the eye, but generally poses much less of a threat than ocular focus light, which gets focused 10^5 times to a 10-*u*m diffraction-limited spot on the retina. When viewed head-on the beam strikes the *fovea*, the region responsible for the most accurate vision. When struck sideways, the beam strikes part of the retina responsible for peripheral vision. If it hits the so-called *blind-spot* -- the place where the optic nerve enters the eye -- loss of vision is complete. Laser light inside the ocular focus range but outside the visible 0.4-0.75 *u*m range poses a particular hazard -- *although it is invisible, it will get focused inside the eye*.

Because of the tight focusing inside the eye, exposure to even a very weak laser beam can instantaneously lead to permanent damage (see attached case histories 1 and 2). A HeNe laser exceeding 0.3 mW is already classified as a class III laser (the classification runs from class I, the only class considered *eye-safe*, to class IV, considered hazardous to both eyes and skin). The danger is not just being struck by the full laser beam: a mere 4% reflection of a laser beam from a glass slide will result in permanent eye-damage. To give you an idea: the maximum permissible exposure (0.15 s) for a continuous HeNe laser is reached at just 1 mW. The *burn*-threshold of the retina of a rabbit is only about a factor 30 higher.

Dangers:

The major dangers are associated with horizontal stray beams at table height; beams traveling out of the plane of the table; reflections off optical components, watches, belts, clothing. Any of these could lead to unexpected exposure to a laser beam. The rules below are meant to prevent such an accident and to ensure the safety of researchers and visitors.

Material for this handout was adapted from information at
http://galileo.harvard.edu/mazur-www/News/LaserSafety.html and
http://www.osha-slc.gov/OshDoc/Directive_data/PUB_8-1_7.html

03/30/99

EEC136 Standard Operating Procedures for Lasers

1) **Never aim the laser at an individual's eye.**

2) **Accidental reflections**. Watches must be taken off before any alignment. The same holds for other clothing or jewelry that could deflect a beam to eye level (belt buckles, etc.).

3) **Safety goggles**. Goggles *must* be worn whenever available.

4) **Stray beams**. Whoever moves or places an optical component on an optical table is responsible for identifying and terminating each and every stray beam coming from that component. Unsecured pieces of cardboard are *not* suitable beam terminators.

5) **Vertical beams**. In EEC136 the laser beam will never be vertically deflected off the workbench!

6) **Adding components.** When placing new components in a beam path, the laser beam must temporarily be blocked.

7) **Restricted Area**. No visitors, unless accompanied by instructor or teaching assistant, are allowed during a laboratory session. When the lasers are on ***the door must be closed***.

8) **Education**. No person may work in our laboratory without first reading this laser-safety handout. A signed copy will be on file that person has read and agree that failure to follow these rules, as determined by instructor or teaching assistant, will be cause for dismissal from the course.

Rules for visitors when lasers are on:

Admission criteria. Absolutely no admission:
1) to anyone under 5 ft., especially children.
2) when any cover is removed from a laser system.
3) when there are any stray beams off the optical tables.

Admission information. Every visitor must be accompanied and be told to:
1) be aware of the potential hazards for eye-injury and *permanent loss of vision*
2) never bend down or sit down.
3) absolutely never bend over the edge of any optical table.

Additional recommendations:

1) Safety goggles should be worn whenever feasible/practicable -- not just when working on commercial laser systems
2) When wearing eye-glasses it is important to be aware of the potential danger of being caught *from behind* by a (reflection of a) laser beam.

LASER HAZARD CLASSES:[1]

Virtually all of the U.S. and international standards divide all lasers into four major hazard categories called the laser hazard classifications. The basis of the classification scheme is the ability of the primary or reflected primary beam to cause biological damage to the eye or skin during intended use. The criteria is established relative to the Maximum Permissible Exposure (MPE) levels that are accessible during operation of the laser. Lasers and laser systems are assigned one of four broad Classes (I to IV) and Optical Fiber Communications Systems (OFCS) are assigned one of four service groups (SG1, SG2, SG3a, SG3b) depending on the potential for causing biological damage.

CLASS I:

Cannot emit laser radiation at known hazard levels (typically CW: 0.4 µwatts at visible wavelengths). Users of a Class I laser products are generally exempt from radiation hazard controls during operation and maintenance (but not necessarily during service). Since lasers are not classified on beam access during service, most all Class I industrial lasers will consist of a higher class (high power) laser enclosed in a properly interlocked and labeled protective enclosure. In some cases, the enclosure may be a room (walk-in protective housing) which requires a means to prevent operation when operators are inside the room.

CLASS II:

Low power visible lasers which emit above Class I levels but emitting a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person.
NOTE: Class IIA is a special designation that is based upon a 1000 second exposure and applies only to lasers that are "not intended for viewing" such as a supermarket laser scanner. The upper power limit of Class IIA is 4.0 µW. These are products whose emission does not exceed the Class I limit for an emission duration of 1000 seconds.

CLASS IIIA:

Intermediate power lasers (CW: 1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended.
NOTE: There are different labeling requirements for Class IIIA lasers with a beam irradiance that does not exceed 2.5 mW/cm(2) (Caution logotype) and those where the beam irradiance does exceed 2.5 mW/cm(2) (Danger logotype).

CLASS IIIB:

Moderate power lasers (CW: 5-500 mW, pulsed: 10 J/cm^2 - or the diffuse reflection limit, which ever is lower). In general, Class IIIB lasers will not be a fire hazard nor are not generally capable of producing a hazardous diffuse reflection except for conditions of intentional staring done at distances close to the diffuser. Specific controls are recommended.

CLASS IV:

High power lasers (cw: 500 mW) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

EMBEDDED LASER:

A Class II, Class III, or Class IV laser or laser system contained in a protective housing and operated in a lower classification (Class I, Class II or Class III). Specific control measures may be required to maintain the lower classification.

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[1] OSHA Directives PUB 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

OPTICAL FIBER COMMUNICATION SYSTEMS (OFCS):

Optical Fiber Communication Systems (OFCS) and the associated optical test sets use semiconductor lasers or LED transmitters that emit energy at wavelengths typically greater than 700 nm into the lightguide fiber optic cables.
All OFCS are designed to operate with the beam totally enclosed within the fiber optic and associated equipment and, therefore, are always considered as Class I in normal operation. The only risk for exposure would occur during installation and service when lightguide cables are disconnected or during an infrequent accidental cable break.
Optical Fiber Communication Systems (OFCS) are assigned into one of four service group designations: SG1, SG2, SG3a, SG3b, depending on the potential for an accessible beam to cause biological damage. The service group designations relate to the potential for ocular hazards to occur only during accessible beam conditions. This would normally occur only during periods of service to a OFCS. Such designations apply only during periods of service in one of the following four service groups (SG):

SERVICE GROUP 1:

An OFCS that is SG1 has a total output power that is less than the Accessible Emission Limit (AEL) for Class I and there is no risk of exceeding the Maximum Permissible Exposure (MPE) when viewing the end of a fiber with a microscope, an eye-loupe or with the unaided eye.

SERVICE GROUP 2:

An OFCS is SG2 only if wavelengths between 400 and 700 nm are emitted and is potentially hazardous if viewed for more than 0.25 s. (Note: at present, there are virtually no OFCS that operate in this wavelength range.)

SERVICE GROUP 3A:

A SG 3A OFCS is not hazardous when viewed with the unaided eye and is hazardous only when viewed with a microscope or an eye-loupe.

SERVICE GROUP 3B:

OFCS which meet none of the above criteria are designated as SG 3B.
NOTE: OFCS where the total power is at or above 0.5W do not meet the criteria for optical fiber service group designation. In this case, the OFCS are treated as a standard laser system.

All invisible diode lasers (i.e. NOT in the 400 and 700 nm range) in EEC 135 are CLASS IIIB!

CASE HISTORIES

CASE HISTORY NO. 1

This is an accident victim's viewpoint of his experience.[2]

"The necessity for safety precautions with high-power lasers was forcibly brought home to me last January when I was partially blinded by a reflection from a relatively weak neodymium-yag laser beam. Retinal damage resulted from a 6-millijoule, 10-nanosecond pulse of invisible 1064-nanometer radiation. *I was not wearing protective goggles* at the time, although they were available in the laboratory. As any experienced laser researcher knows, goggles not only cause tunnel vision and become fogged, they become very uncomfortable after several hours in the laboratory. When the beam struck my eye I heard a distinct popping sound, caused by a laser-induced explosion at the back of my eyeball. My vision was obscured almost immediately by streams of blood floating in the vitreous humor, and by what appeared to be particulate matter suspended in the vitreous humor. It was like viewing the world through a round fishbowl full of glycerol into which a quart of blood and a handful of black pepper have been partially mixed. There was local pain within a few minutes of the accident, but it did not become excruciating. The most immediate response after such an accident is horror, As a Vietnam War Veteran, I have seen terrible scenes of human carnage, but none affected me more than viewing the world through my bloodfilled eyeball. In the aftermath of the accident I went into shock, as is typical in personal injury accidents. As it turns out, my injury was severe but not nearly as bad as it might have been. I was not looking directly at the prism from which the beam had reflected, so the retinal damage is not in the fovea. The beam struck my retina between the fovea and the optic nerve, missing the optic nerve by about three millimeters. Had the focused beam struck the fovea, I should have sustained a blind spot in the center of my field of visions. Had it struck the optic nerve, I probably would have lost sight of that eye.
The beam did strike so close to the optic nerve, however, that it severed nerve-fiber bundles radiating from the optic nerve. This has resulted in a crescent-shaped blind spot many times the size of the lesion. [...] The effect of the large blind area is much like having a finger placed over one's filed of vision. Also, I still have numerous floating objects in the field of view of my damaged eye, although the blood streamers have disappeared. These `floaters' are more a daily hindrance than the blind areas, because the brain tries to integrate out the blind area when the undamaged eye is open. There is also recurrent pain in the eye, especially when have been reading too long or when I get tired.

The moral of all this is to be careful and wear protective goggles when using high power lasers. The temporary discomfort is far less than the permanent discomfort of eye damage. The type of reflected beam which injured me also is produced by the polarizers used in Q switches, by intracavity diffraction gratings, and by all beamsplitters or polarizers used in optical chains."

The victim of Case History No. 1 explained that protective goggles were not being worn at the time, although they were available in the laboratory. He also stated, "As any experienced laser researcher knows, goggles not only cause tunnel vision and become fogged, they become very uncomfortable after several hours in the laboratory." This statement substantiates the author's contention that management of eye protection must include knowledge of all types of eyewear and not accept the myth that heavy, uncomfortable goggles must be worn to ensure safety.

CASE HISTORY NO. 2

Another viewpoint from a victim describing the circumstances of an accident follows:[3]

"As I read my November issue of *Laser Focus* I took note of the eye injury report, curious about the particulars of this novel accident. Even though I have been working with lasers for five years in the presence of many of the same hazards pointed to in this article, I didn't think while reading it, "This could happen to me!" But it did. On January 22, 1982, I spent several hours aligning a low-power, frequency-doubled Nd:YAG beam through a dye laser set-up. In order to see the 532 nm pump beam propagation *I was not wearing goggles*. I had also removed a beam block intended to absorb a Brewster's angle reflection, to observe end pumping of an amplifier cell. The green power was increased to determine the extent of dye lasing without replacing the beam block. I did not put on goggles. While placing a power meter at the dye laser output I leaned over the uncovered amplifier and caught a reflection in my

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[2] *Laser Focus*, 1977
[3] *Laser Focus*, 1982

right eye. Because I was in continuous motion looking at the meter and not the beam, I doubt that more than one 10 to 15 nsec pulse of ~20 microjoules was focused onto the fovea. While I do remember seeing a green flash there was no pain. I was not immediately aware of any significant eye damage. It wasn't until I shut the lasers off and returned to my desk to record the day's activity that I realized I had a blind spot comparable to a camera flash, but only in my right eye. It was almost 5:00 on a Friday, and I didn't report the incident because I couldn't believe that any serious damage was done. By Saturday afternoon I knew I had a problem. Monday the 25th I notified our safety division and started my visits to an ophthalmologist. The initial examination supported the probability of permanent damage although hemorrhaging in the affected area obstructed detail. By the end of the first week, peripheral vision around the spot was improving (due to decreased swelling), and the actual contact point was observed to be on the right side of the macula (that corresponds to a blind spot slightly off center left). I was encouraged and felt fortunate considering the negative potential of this careless mistake. But by week two peripheral vision had declined. Distortion (curving) of resolution around the spot became more noticeable due to additional blood pooling around the retina. If this hemorrhaging were to persist, laser cauterization would be necessary. But for now "treatment" consists of waiting, observing, and photographing. Although recovery has not been straightforward, and my vision may get worse before it gets better, I still feel lucky in that one eye totally escaped injury. So while reading was difficult at first, my daily life has remained largely unaffected because the brain and stereo vision compensate the anomaly. But more important than the actual event is the idea that this incident could have been avoided. Don't let it happen to you or a co-worker. "

CASE HISTORY NO. 3

On April 15, 1971, a 31-year old man with many year's experience with lasers was struck in the left eye with an argon laser beam, causing an immediate paracentral visual blur. Circumstances of injury were as follows: *Without wearing his safety glasses*, the patient was inspecting a clear glass laser beam splitter for dust particles as part of the normal production line procedure. During this examination, laser power was accidentally turned on by another person, causing the beam to strike the patient's eye. The laser was continuous wave argon with wavelengths of 4,880 and 5,145 Å Power incident at the cornea was 70 mW and beam diameter was 1.4 mm. The exposure duration depended on the blink reflex of the patient, estimated as being 0.125 seconds.

References:

1) OSHA Directives PUB 8-1.7 - Guidelines for Laser Safety and Hazard Assessment
http://www.osha-slc.gov/OshDoc/Directive_data/PUB_8-1_7.html

2) UC Davis Safety Net Standard Operating Procedures for Lasers or Laser Systems

http://ehs.ucdavis.edu/sftynet/radio/sn-76.html

03/30/99

I have read the EEC136 Laser Safety Handout.

I am familiar with the EEC136 Standard Operating Procedures for Lasers.

I have been informed and agree that failure to follow Standard Operating Procedures for Lasers will be cause for dismissal from EEC136.

First Name: ______________________________

Last Name: ______________________________

Signature: ______________________________

Date: ______________________________