

Satellite Laser Ranging (SLR) International Workshop
Safety Best Practices Discussion – Clinic Group
Chris Quinn

The Safety Best Practice Discussion Group is intended to share SLR station safety program best practices from across the network in hopes that other groups might be able to implement and benefit from these strategies at other locations.

Beyond best practices, the forum will also provide an opportunity to ask the group safety related questions. To help facilitate brainstorming for this discussion, the below information has been provided:

- Sample Laser Safety Self-Audit – Simple laser safety audit from Princeton University available online at <https://web.princeton.edu/sites/ehs/labpage/LaserSafety.pdf>.
- Sample simple Safety and Health Audit to evaluate your basic safety program. This is not intended to be a comprehensive safety or health audit questionnaire, but a short list to assess the basic building blocks of a safety and health program.
- Presentation on ANSI Z136.1 Update – Presentation providing an overview of the changes made for the American Standard for safe use of lasers from Rockwell Laser Institutes, which is now available for purchase. Presentation is available at <http://www.rli.com/Products/Product.aspx?idproduct=782>.
- Sample Job Safety Analysis and a Pre-Planning Task Sheet which are used by the SCNS contract for performing hazard assessments for routine and non-routine tasks respectively. Hazard assessment methods used across the SLR network will be discussed.
- Safety Poster from last year – Poster created by Exelis and was on display during last year's conference.

Please consider the below questions to spur good discussion during the best practice discussion.

1. Briefly review the sample Laser Safety Self-Audit and the Safety and Health Audit. Consider items that you believe your station has a best in class approach or those that you believe are a gap at your site. Please share your thoughts with the group?
2. What processes does your site implement to identify hazards in the work area? How often are they performed? Are they documented?
3. What do you think are the top 5 hazards associated with SLR stations? What controls do we implement to protect personnel?
4. Are there other best practices you think could be shared with the network or gaps we could address improving safety at the stations?

Group Discussion led – Chris Quinn, CSP

This open forum discussion will be led by Chris Quinn who is a Certified Safety Professional and manages the Environmental, Safety, and Health programs for Exelis' Space Communications Network Services (SCNS) contract, which includes both the MOBILAS 4 and 7 Stations. He has a B.S. Degree in Environmental Science from Towson University and a Master's Degree in Safety Sciences from Indiana University of Pennsylvania.

Sample Safety and Health Audit

Sample audit was developed to be a simple safety and health audit to evaluate a basic safety and health program elements and was developed to initiate discussion during the upcoming SLR International Workshop. Please note this is not a comprehensive listing of all environmental, safety or health requirements.

#	Audit Question	Yes	No
1	Does your site have a written Safety and Health Program that details procedures for the following: <ul style="list-style-type: none"> - Management commitment and methods for employee participation in the safety program - Organizational safety responsibilities - Hazard identification and risk assessment methodologies - Hazard control - Safety communication - Methods for reporting mishaps, close calls, hazards, and employee suggestions - Training and awareness - Personal Protective Equipment - Incident investigation 		
2	Does your site performing hazard assessments and risk assessment for tasks (examples may include job safety analysis, job hazard analysis, preplanning worksheets, etc.)?		
3	Does your site perform documented periodic safety inspections?		
4	Does your site have emergency procedures for planning and response to potential emergency and disasters for the site such as medical emergencies, fires, and other events?		
5	Does your site provide safety and health training to employees necessary to perform work safely (e.g., Hazard Communication, Control of Hazardous Energy, Electrical Safety, Laser Safety, Emergency Procedures, On-the-job training on equipment and procedures, etc.)?		
6	Does your site evaluate all new changes for environmental, safety, or health impacts (Changes may include new equipment, procurements, etc.)?		
7	Does your site have a hazard communication plan that details how your site manages hazardous chemicals, maintenance of safety data sheets, and communicates hazards to employees, visitors, and contractors?		
8	Has your site developed electrical safety procedures for employees performing work near or on live electrical components greater than 50 volts (e.g., testing and troubleshooting, etc.)?		
9	Does your site have procedures to control hazardous energy during maintenance and service (e.g., Lockout/Tagout)?		
10	Does your site provide personal protective equipment (e.g., safety glasses, laser eyewear, gloves, etc.) as required to protect personnel as well as provide training on its use and limitation?		

**Laser Safety
Self-Audit Checklist**

Building _____ Room _____ Principal Investigator _____ Date _____

Audit Performed by _____

	Y	N	NA	COMMENTS
A. Administrative				
1. Lasers are classified appropriately (2, 3a, 3b, 4a, 4b)				
2. Standard operating procedures are available				
3. Alignment procedures are available				
4. Viewing cards are used for alignment				
5. Laser users attended appropriate training				
6. Lasers are included in inventory				
B. Labeling and Posting				
1. Certification label present				
2. Class designation and appropriate warning label present				
3. Radiation output information on label				
4. Aperture label present				
5. Appropriate warning/danger sign at entrance to laser area				
6. Warning posted for invisible radiation				
C. Control Measures				
1. Protective housing present and in good condition				
2. Beam attenuator present				
3. Laser table below eye level				

Key to Laser Safety Checklist

A. Administrative

1. Lasers are classified by the manufacturer, but must be reclassified by the principal investigator if the system is altered or constructed in the laboratory. Class 2 designates lasers in the visible range (400-700 nm) where radiant power does not exceed 1 mW. Class 3a designates visible lasers with 1 – 5 mW radiant power. Class 3b designates lasers with radiant power ranging 5 mW – 500 mW. Class 4 lasers have radiant power exceeding 500 mW.
2. Self-explanatory
3. Self-explanatory
4. Self-explanatory
5. All faculty, staff and students operating Class 2, 3 or 4 lasers must attend training given by EHS.
6. All lasers must be included in the Princeton University laser inventory maintained by EHS. Any new laser system must be reported to EHS at 258-5294.

B. Labeling and Posting

1. The manufacturer's certification label must be affixed to the laser housing.
2. The laser housing must bear a sticker which includes the class designation and appropriate warnings.
3. The laser labeling must include the output radiant energy or power.
4. Self-explanatory.
5. At the entrance to the room, the following signage is necessary:
Class 2: CAUTION, Laser Radiation (or laser symbol), Do Not Stare Into Beam
Class 3a: DANGER, Laser Radiation (or laser symbol), Avoid Direct Eye Exposure
Class 3b: DANGER, Laser Radiation (or laser symbol), Avoid Direct Exposure To Beam
Class 4: DANGER, Laser Radiation (or laser symbol), Avoid Eye or Skin Exposure to Direct or Scattered Radiation

6. If laser is not visible range (e.g., not 400-700 nm), warning sign should be posted stating that the beam is not visible.

C. Control Measures

1. Self-explanatory
2. Self-explanatory

Laser table should be set up such that the beam is below eye level when sitting or standing.

	Y	N	NA	COMMENTS
4. Beam is enclosed as much as possible				
5. Beam not directed toward doors or windows				
6. Beams are terminated with fire-resistant beam stops				
7. Surfaces minimize specular reflections				
8. Controls are located so that the operator is not exposed to beam hazards				
D. Personal Protective Equipment				
1. Eye protection is appropriate for wavelength				
2. Eye protection has adequate OD				
3. Warning/indicator lights can be seen through protective filters				
E. Class 3b and 4 Lasers				
1. Interlocks on protective housing				
2. Service access panel present				
3. Limited access to spectators				
4. Nominal hazard zone determined				
5. Operators do not wear watches or reflective jewelry while laser is operating				
6. Viewing portals present where MPE is exceeded				
F. Class 4 Lasers				
1. Failsafe interlocks at entry to controlled area				
2. Area restricted to authorized personnel				
3. Laser may be fired remotely				

Key to Laser Safety Checklist

Control Measures (continued)

3. Self-explanatory
4. Self-explanatory
5. Self-explanatory
6. Self-explanatory
7. Self-explanatory
3. It is strongly recommended that the laser be monitored and fired remotely.
4. Self-explanatory.

D. Personal Protective Equipment

1. Eye protection should bear markings indicating the optical density and wavelength that the eyewear protects
2. Optical density must be appropriate for the laser system.
 $OD = \log_{10} (\text{anticipated worst case exposure in } W/cm^2 \text{ or } J/cm^2) / MPE$
3. Self-explanatory

E. Class 3b and 4 Lasers

1. Interlocks must be provided on removable parts of the housing.
2. Service access panels should be interlocked or require a tool for removal.
3. Spectators must be provided appropriate personal protection and be warned of the associated hazards of the laser.
4. The Nominal Hazard Zone must be calculated and marked to warn individuals within the NHZ that protective equipment is needed.
5. Watches and reflective jewelry may create hazardous specular reflections.
6. Recommended.

F. Class 4 Lasers

1. It is strongly recommended that interlocks be placed at entryways to the controlled area such that the laser system shuts down upon entry of unauthorized personnel.
2. Self-explanatory. Visitors or spectators must be warned of hazards and given protective equipment.

	Y	N	NA	COMMENTS
4. If present, curtains are fire-resistant				
5. Area designed to allow rapid emergency egress				
6. Pulsed – interlocks designed to prevent firing of the laser by dumping the stored energy into a dummy load				
7. CW – interlocks designed to turn off power supply or interrupt the beam by means of shutters				
8. Operators know not to wear ties around the laser				
G. Non-Beam Hazards				
1. High voltage equipment appropriately grounded				
2. High voltage equipment located away from wet surfaces or water sources				
3. High voltage warning label in place				
4. Compressed gases secured				

Key to Laser Safety Checklist

5. Self-explanatory.
6. Self-explanatory
7. Self-explanatory
8. Ties may accidentally get into the path of the beam

G. Non-Beam Hazards

1. Self-explanatory.
2. Self-explanatory. Operators should take care not to handle electrically charged equipment when hands are wet or sweaty.
3. Self-explanatory.

Cylinders should be secured to the wall or to a stationary object to avoid tipping or falling.