



MEMORANDUM

TO: SLAC Laser Personnel and Laser Safety Committee
 FROM: Mike Woods, Laser Safety Officer
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 Sayed Rokni, Radiation Protection Department Head
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 SUBJECT: Skin Hazard and Skin Protection Requirements for UV Laser Radiation
 DATE: June 13, 2012

Laser Safety Technote 2012-1 [1] examines the potential for hazardous skin exposures to ultraviolet (UV) laser radiation and provides guidance for safety controls to protect the skin. The Technote summarizes skin hazard descriptions and controls requirements related to UV lasers found in the ANSI safety standard and the OSHA Technical Manual on Laser Safety, as well as in laser safety programs at LLNL, LBNL and Stanford. The Technote also presents examples of UV laser operation with calculated MPEs (Maximum Permissible Exposures) and NHZs (Nominal Hazard Zones; i.e. regions where the exposure may exceed the MPE).

SLAC laser personnel, in particular SLSOs, are requested to review Laser Safety Technote 2012-1 and follow the guidance given to minimize skin exposure to UV laser radiation. This topic and associated policy requirements were discussed at the March 14, 2012 meeting of the Laser Safety Committee (LSC). [2]

This LSO Memo summarizes general comments about skin hazards from UV exposures and gives updated policy requirements for skin protection for UV lasers which will be included in a revision to ESH Manual Chapter 10, Laser Safety.[3] Templates for the OJT syllabus,[4] SOP document [5] and Laser Safety Contract [6] have already been updated to address this issue. ESH courses 131, *Laser Lessons Learned*, and 130, *Laser Safety for Supervisors*, will also be updated to address skin protection for UV lasers. Vendor information for skin PPE can be found in [7].

General Comments about Skin Hazard for UV exposures

- Eye and skin MPEs are the same in the UV and in the IR outside of the retinal hazard region. In the retinal hazard region between 400-1400nm, eye MPEs are ~x100-1000 less than skin MPEs for a 1000s exposure.
- MPEs in the UV are the same for coherent (laser) and incoherent sources.
- MPEs in the UV depend on the cumulative exposure. For example the MPE is $3\text{mJ}/\text{cm}^2$ between 180-300nm for exposures from 10^{-9} s to 1000s. The potential hazard from long exposures to diffuse reflections must be considered.
- Skin injuries are less serious than eye injuries
 - Vision impairment has much higher consequences
 - Skin injuries are usually self-repairing
- Skin injuries are much more probable than eye injuries
 - Large surface area
 - Hands close to laser beams

Laser Safety Policy Updates for Class 3B and Class 4 UV laser operation

Skin protection can best be achieved with engineering controls – enclose UV laser beam paths as much as practical. Caution: when there are open beams, PPE for eye and skin protection are providing primary protection to accessible diffuse reflections.

1. Engineering Controls (enclosures and barriers)
 - Enclose UV laser beam paths to extent practical. If they can't be enclosed, then implement adequate barriers to minimize potential skin exposure from chronic exposure to beam losses and other sources of diffuse reflections.
 - Beam dumps. Design barriers or enclosures for beam dumps to minimize potential exposure to diffuse UV reflections from them.
2. Administrative procedures
 - Attenuate laser beam to minimum power required when there are open UV laser beams, in particular when alignment is done.
 - Use remote steering controls and diagnostics as much as practical for aligning UV laser beams.
 - Plan work so minimize time with potential skin exposure to hazardous UV laser beams.
 - Keeps exposed skin as far as practical from open beams.
3. PPE for skin
 - Wear long-sleeved shirts.
 - Use gloves when working with hands near accessible laser beams (direct beam exposure hazard for primary or stray beams).
 - Use gloves when diffuse reflection NHZ > 20cm if hands may be within this distance of an open beam path when diffuse reflections may not be well shielded.
 - Use face shield when diffuse reflection NHZ > 1m if working within this distance of an open beam path when diffuse reflections may not be well shielded.
4. Medical exams
 - Skin exams can be performed by SLAC Medical for laser personnel.
 - Periodic skin exams are recommended for laser personnel who may have chronic exposures exceeding MPE values.
5. Site-specific training
 - On-the-Job Training (OJT) and the SOP document (or Laser Safety Contract) need to describe the potential for skin injury and controls to use. These need to emphasize barriers and enclosures for UV beams and when to use skin PPE.

References

1. *Skin hazard and guidance to protect skin from long exposures to UV laser radiation – e.g., from diffuse reflections*, [Laser Safety Technote 2012-1](#), June 2012.
2. [Minutes](#) from March 14, 2012 Laser Safety Committee meeting.
3. [ESH Manual Chapter 10, Laser Safety](#).
4. The OJT syllabus template is linked from <https://slacspace.slac.stanford.edu/sites/esh/rp/laser/Training>.
5. The SOP template is linked from <https://slacspace.slac.stanford.edu/sites/esh/rp/laser/SOPs/>.
6. The Laser Safety Contract template is linked from <https://slacspace.slac.stanford.edu/sites/esh/rp/laser/LaserSafetyContracts>.
7. Skin PPE vendor information, see SkinProtectionPPE file linked from https://slacspace.slac.stanford.edu/sites/esh/rp/laser/PPE_EyeSkin_Protection/.