NAVAL POSTGRADUATE SCHOOL

NPS FY16
Annual Refresher
Laser Safety Training
20OCT16

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Laser Safety

Purpose

• This training fulfills the mandatory annual refresher training requirements for use of Class 3B and 4 lasers as prescribed by OPNAVINST 5100.27B, ANSI Z136.1, and NAVPSCOLINST 5100.27A
  – (1) Laser fundamentals.
  – (2) Standard operating procedures, laser system specifications, hazard data, and control measures for laser systems.
  – (3) Manufacturer's operating information, LSRB safety information and any other safety requirements.
  – (4) Eye protection to be worn and any other personal protective equipment required.
  – (5) Review of medical surveillance program/requirements.
  – (6) Review of local range standard operating procedures/ regulations
  – (7) Review of maintenance precautions/requirements for personnel conducting maintenance

* Not a substitute for Initial Laser Safety Training. Contact the LSSO for Initial Training if required.
Last year,

- The entire inventory of Class 3B and 4 lasers were reviewed and confirmed. As of 06SEP16, there are 101 Class 3B and 4 systems.
- 14 Permits are active. All were audited and updated. 3 Permits were retired. 2 are new.
- 16 personnel completed Initial Laser Training requirements. 12 personnel departed. 30 are currently active. 2 are scheduled to depart this December, and 8 expected to become enrolled in the next month.
- The IG performed a NPS Laser Safety Inspection. The program was noted to be satisfactory with zero discrepancies.
- A rewrite of the NPS Laser Instruction was directed by the Dean of Research. It is expected to considerably change the directions for the LSC, capture the Permit process better, and reduce in size from 28 pages to 13. The update is currently in review with the LSC and Safety Staff.

Laser Permits and Authorizations will be reviewed OCT-DEC 2016
Also completed in FY16:

- JIFX 16-1, 16-3, and 16-4 laser operations
  - Class 4 Laser Bullet Tracking Aimpoint Corrector demo at 16-1 handed off to USArmy and industrial sponsor. This experiment was too hazardous for Navy management. Army conduct precluded Navy LSRB review. Unfortunately, Navy and Marine Corps personnel were prohibited from attending the demo inside the Laser Hazard Zone (750 meters), but could observe from the protection of the control trailer.
  - Class 1M FSO communications systems experiments at 16-4 were conducted across 7 miles of Camp Roberts controlled areas according to SOP developed by NPS and the industrial sponsor. Formal Navy LSRB review was directed by the Navy Technical Lead Agents and requested prior to operations. Formal LSRB endorsement was received about 2 months later.

- Both NPS military exempt Class 4 Laser Target Designators were transferred to NSWC Point Magu.
- 4 Laser pointers submitted for disposal (labeled Class 3B)
- Laser recurring items migrated into ESAMS, but the results have been somewhat ineffective.
- 9 KFS reviews for Laser acquisitions
- 11 Contracts reviewed for Laser Safety elements
- Laser Safety Committee (LSC) continues quarterly program reviews - minutes available
- Everyone’s Annual Refresher Training has lapsed – please complete this PPT.
This year we’ll review the fundamentals of Diode Lasers

- Population inversion at the pn-junction occurs with voltage.
- Under favorable conditions, stimulated emissions result.
- Material properties can provide an optical cavity that capture and (sort of) collimate.
- Applications can be tiny.
- Apertures as small as 1 micron may cause large divergence.
- Elliptical shaped beams common due to width>height at aperture.
• Common to capture a diode laser output, refocus it into a fiber optic

• Diameter and index of refraction (dope-able) matters

• A temporal signal can be transferred accurately, or energy can be spread

• Watch for cracks, kinks, and loose fibers. Escaping energy can be hazardous
For Control Measures this year, here is the NPS process for a Class 3B or 4 laser system to become operational. Since you are all already Workers or Custodians, we’ll dive on the LHA, ORM, and SOP.

- Requirements to operate Class 3B and Class 4 laser systems
  - Meet the General Laser Lab Safety Requirements
    - NPS Initial Laser Safety Training and 70% or greater on the quiz
    - Baseline Medical Exams Completed
    - Laser(s) Permitted to a Custodian and approved for use by the NPS LSSO
      » Laser Hazard Analysis (LHA) and NOHD/NHZ defined
      » Deliberate Operational Risk Management (ORM) Assessment completed
      » Standard Operating Procedures (SOP) approved by the LSSO
      » Site Inspection
  - Complete System Specific training (LHA, ORM, SOP, and Permit review, review manufacture's directions)– document in the Laser Log
Control Measures 2016

• **LHA**
  – Completed by the LSSO with inputs from the Custodian
  – Mission and operating environment can be very important
  – Consider aided viewing
  – Can be done freehand or DoD software tool
    • LHAZ 5.2 current USAF issued standard – good for simple cases
    • Freehand potentially required for complex systems
  – Link to a Sample LHA is in the backup slides

• **Deliberate ORM Assessment**
  1. Identify the Hazards – from LHA
  2. Assess the Hazards – consider mission, environment, and consequences
  4. Implement Controls – with SOP, Permits
  5. Supervise – with SOP, Laser Log, Permits
  – There are 2 templates for NPS laser ORM – both are in backup slides
• **SOP**
  - Written by the Custodian
  - Approved by the LSSO
  - Shall incorporate ORM mitigations
  - Shall include Emergency Shut Down
  - Shall include Alignment if system requires this
  - Link to an SOP template is in the backup slides

• **Site Inspection**
  - Final review of all control measures – Permit, Laser Log, system specific training documentation.
  - Final review of engineering controls of the site (space access, signage, interlocks, shields, Emergency Procedure considerations,)
  - Typically this is the last step and is a graduation exercise. After this step, Custodians are free to operate IAW the SOP.
Three efforts with the LSRB in 2016

1. JIFX 16-1 bullet tracking experiment required LSRB approval.
   - Hazards were critical, Class 4 system outdoors
   - JIFX timeline failed to allow for an appropriate Navy LSRB review
   - NPS transferred this operation to US Army
   - Navy and Marine Corps Personnel prohibited from experiment DEC2015
   - LSRB followed up with a line of questioning on how we allowed this. LSRB was satisfied with the solution when fully explained.

2. JFIX 16-4 FSO Class 1M Communication
   - Informal discussion with the LSRB led to an order for NPS to request a formal LSRB review
   - Formal LSRB review request package (LHA, ORM, SOP, range survey) submitted. Slow LSRB response, indigenous analysis of negligible risk, and unique window of opportunity resulted in NPS leadership approval to operate AUG2016
   - LSRB approval received on 18OCT16 – Range, Training, and SOP guidance captured

3. Transfer of Mil Exempt Lasers to NSWC Point Magu
   - Formal transfer request letter to LSRB required along with 1149
   - LSRB approval provided by the Administrative Lead Agent (ALA) by email, but letterhead request still mandated
   - No formal response yet – but the transfer is complete
A current event to consider for our pulse laser systems:

- From the 2016 DoE Laser Safety Workshop presentations, preliminary results were released regarding vulnerabilities measured in LEP applied to ultrafast, high energy Class IV laser systems.

- NIST researchers uncovered severe degradation in eye protection as pulses became ultrafast. The soon-to-be-published report revealed that some national brand LEP tested and certified to the current published standards failed disastrously in the ultrafast environment.

- As the data was yet to be published, a general warning was offered for operators of ultrafast systems to test LEP for advertised performance if possible.
Some slight changes – here is the 2016 gouge

• **Baseline:** prior to first use of a class 3B or 4 laser at NPS
• **Incident:** Over-exposure/mishap
• **Exit:** Post-employment (always a challenge)

• If you have new Laser Custodians or Workers, please get them Initial Training, Quiz (updated OCT2016), and start the forms and scheduling for the Baseline Eye Exam (see next slide)

• **Periodic exams not required**
Laser Safety Program Baseline Exam (30 days):  
1. Fill out the fillable PDF SECNAV INST 5100/1 Medical Referral Form with digital supervisor signatures. This form is available with LSSO referral information pre-filled, on the NPS Laser Safety website: https://my.nps.edu/web/safety/laser.  
2. Email the supervisor-signed Referral Form to the Presidio Health Clinic scheduler Thu Vo at thu.vo5.civ@mail.mil. Then call her at 831-242-5332 to schedule. Backup: Flora Delapena at 831-242-4842, flora.r.delapena.civ@mail.mil.  
3. Follow through and arrive on time to complete your exam.  
4. The clinic should give you a copy of the 5100/1 with the doctors signature upon completing this exam. Keep this for your records. If NPS doesn’t get a receipt from the clinic, LSSO may ask you for a copy to prove completion.  

Laser Safety Program Exit Exam (30 days):  
1. Same as Baseline.  
2. Congrats! You are now legal to Graduate or Transfer.  
3. If active duty personnel depart without completing, NPS has successfully captured this at their follow-on command!  

If a Laser Incident Occurs (immediately):  
1. If injury suspected, call (9)911 for the Emergency Room nearest. For NPS it will be CHOMP. Expect to be referred immediately to an ophthalmologist.  
2. Notify the LSSO (sagiles@nps.edu, 831-656-7568, Ha285). LSSO will notify HRO, Presidio of Monterey Health Clinic, and several others.
This year, let’s looks at JSF Electro Optical Targeting System (EOTS) hazard zone considerations.

In the international arena, its hard to find a higher dollar, higher profile program than the JSF. When international partners take to the public media to air out concerns, it’s safe to say there’s some heat on at the respective program and safety offices.

According to a 1 AUG article by The Register, “F-35 targeting system laser will be 'almost impossible' to use in UK”. Standoff includes “a ban on any optic devices being within 33km of the aircraft when the designator is switched on, and no observers being allowed within 9km of an F-35 operating its designator laser.”

The British MoD was concerned that this would force training events to ranges in the north of England and off the coasts of Scotland and Wales where EOTS could be used within the rules. The UK’s F-35 team are said to be in talks with the US to have the issue reviewed.

Let’s hope those programs have their LHA, ORM and SOP in good order!

It appears the challenge of finding suitable ranges for laser work is hardly unique to NPS.
• Laser Custodians are **required** to conduct Annual Laser Specific Training for their designated laser workers.

• **Please** take this reminder as an action to **Schedule and Conduct training** for your system, and **for your Permitted Workers**.
  – Review System Specifications, LHA, ORM, SOP
  – Review Manufacturer’s instructions
  – Inspect and show PPE, site engineering controls

• **Document** the training in your laser firing log:
  – Date, WHO attended
  – What specific laser training was provided (i.e review of LHA, ORM, SOP, review of manufacturer’s instruction manual, other training – should be pretty close to what is noted above)

• The LSSO will update the NPS records during the OCT-DEC Laser Permit and Authorization inspections.
• This has reviewed the 7 topics required by OPNAV to constitute general Annual Safety Refresher Training, and then some.

• Schedule and complete your annual system specific reviews with your Workers – please record this in the Laser log.

• Please email sagiles@nps.edu with the answer to the completion question to officially record this annual refresher training.

• Your training will be logged and tracked for currency.
  – Your permit and authorization to use NPS lasers will be contingent upon completion of the annual training within the last 12 months.
  – Expect next annual training SEP 2017!
Back-up:
NPS Laser Template Links

• **LHA Sample:**
  - [Naval Postgraduate School Sample Laser Hazard Analysis (LHA)](https://ui.nps.edu/documents/103425239/106393253/Risk-Assessment-Form.pdf/8b240a23a7b3-4f1d-9b64-d0ca3b7b5eed)

• **NPS Laser ORM**
  - [Laser Specific: Naval Postgraduate School Class 3B & 4 Laser ORM Template](https://ui.nps.edu/documents/103425239/106393253/Risk-Assessment-Form.pdf/8b240a23a7b3-4f1d-9b64-d0ca3b7b5eed)
  - General: [https://ui.nps.edu/documents/103425239/106393253/Risk-Assessment-Form.pdf/8b240a23a7b3-4f1d-9b64-d0ca3b7b5eed](https://ui.nps.edu/documents/103425239/106393253/Risk-Assessment-Form.pdf/8b240a23a7b3-4f1d-9b64-d0ca3b7b5eed)

• **SOP Template:**
  - [Naval Postgraduate School Class 3B & 4 Laser SOP](https://ui.nps.edu/documents/103425239/106393253/Risk-Assessment-Form.pdf/8b240a23a7b3-4f1d-9b64-d0ca3b7b5eed)