



Department of Energy
Thomas Jefferson Site Office
12000 Jefferson Avenue
Newport News, Virginia 23606

October 21, 2005

Mr. Craig Ferguson
Associate Director for EH&S
SURA/TJNAF
12000 Jefferson Avenue
Newport News, VA 23606

Dear Mr. Ferguson:

**FINAL REPORT FOR SURVEILLANCE OF THE THOMAS JEFFERSON NATIONAL
ACCELERATOR FACILITY LASER SAFETY PROGRAM, SEPTEMBER 2005**

The attached Surveillance report covers the Site Office's review of the Laboratory's Laser Safety Program conducted on September 13-14, 2005. We are committed to improving the consistency in the conduct of these reviews, the report format, and the terminology used, as to promote the clarity and expectations for all parties. We encourage the Lab to provide feedback on ways to improve the efficiency and coordination of these activities.

For each observation identified in this report, the Lab is expected to submit to the Site Office the disposition or proposed course of action within 30 days of receipt of this report. Had there been any findings identified in the report, the Lab would have been expected to submit to the Site Office a corrective action plan for each finding within 30 days of receiving this report. Such corrective action plans are expected to include the name of the responsible party, and the projected date of closure.

The Lab is again commended for the Noteworthy Practices identified in this report. If there are questions pertaining to this Surveillance, please contact Steve Neilson at extension 7215.

Sincerely,


Scott J. Mallette, Deputy Manager
Thomas Jefferson Site Office

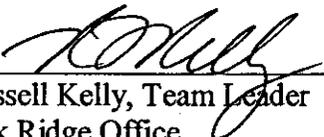
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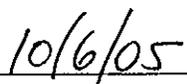
**U.S. Department of Energy
Oak Ridge Office**



**Surveillance of the
Thomas Jefferson National Accelerator Facility
Laser Safety Program
September 2005**



Russell Kelly, Team Leader
Oak Ridge Office



Date

1.0 INTRODUCTION

A surveillance of the Thomas Jefferson National Accelerator Facility (TJNAF or "The Lab") Laser Safety Program was conducted on September 13 and 14, 2005, by Russell Kelly, U.S. Department of Energy (DOE), Oak Ridge Office (ORO), and Steve Neilson, DOE Thomas Jefferson Site Office (TJSO), as requested by TJSO. The surveillance was conducted to evaluate the administration of laser safety activities at TJNAF in accordance with the Review Plan for Laser Safety Program Surveillance (TJSO-2005-003), as much as practicable. The surveillance primarily focused on program administration. Areas such as control selection, posting, non-beam hazards, and equipment labeling were not reviewed unless obvious issues were noted in the field. TJNAF is managed and operated by Southeastern Universities Research Association (SURA) for DOE.

2.0 LIST OF ACRONYMS

ANSI	American National Standards Institute
DOE	Department of Energy
EH&S	Environment, Health, and Safety
ESAF	Experiment Safety Approval Form
FEL	Free Electron Laser
ITS	Injector Test Stand
LSO	Laser Safety Officer
LSOP	Laser Standard Operating Procedure
LSS	Laser System Supervisor
NP	Noteworthy Practice
OBS	Observation
ORO	Oak Ridge Office
SURA	Southeastern Universities Research Association
THz	Terahertz
TJNAF	Thomas Jefferson National Accelerator Facility
TJSO	Thomas Jefferson Site Office

3.0 DISCUSSION OF RESULTS

3.1 Elements Evaluated

The team addressed the following elements and the results are discussed below.

Training and Qualifications

Laser safety training is provided in two parts: initial orientation and laser-specific training. Laser-specific training is the most important aspect of laser safety training because different configurations present different levels of hazards. Laser Standard Operating Procedures (LSOPs) are issued for each laboratory using a Class 3b or 4 laser. Laser-specific training consists of reading the applicable LSOP and a walk-through by the Laser System Supervisor (LSS). The LSS at the Free Electron

Laser (FEL) also administers a test to demonstrate user competency for the FEL operation (NP-1). Entry into the FEL laboratories is via a card reader. The card reader will not allow users to enter into FEL labs (in certain modes of operation) until all required training is complete (NP-2).

New laser users come to the lab with varying experience in laser operations. The LSS is responsible for ensuring the laser-specific training is commensurate with the user's experience and the hazard of the laser setup.

The LSS is delegated the responsibility for laser safety at each applicable laboratory; however, when the required laser user training is completed, it is the user that signs the LSOP indicating successful completion of training (in most cases). The users, effectively, complete the training process by formally authorizing themselves. The LSS should formally authorize laser users upon completion of required training (OBS-1). The FEL LSS formally authorizes users via electronic signature, which appears adequate.

SAF 114, "Laser Safety Class," was reviewed and appears to meet the requirements of American National Standards Institute (ANSI) Z136.1-2000 for general training. The class rosters were spot-checked to ensure that authorized laser users had completed general training. Training records are available via the Lab's intranet, except for the FEL which maintains its own database.

Inconsistencies noted in LSOPs and laser-specific training include methods for formal authorization (noted above), training record management (noted above), varying levels of course descriptions, and varying presentations of hazard analysis. This assessment did not find conditions adverse to safety as a result of these inconsistencies; however, the Lab should consider additional standardization (using best management practices of each LSS) for laser-specific training and LSOPs, in general, to help preclude problems in the future (OBS-2).

Equipment Inspections (Self-Assessment)

The Lab's laser inventory was reviewed and appears to reflect an accurate status of lasers within the facility.

Self-assessments performed by the Laser Safety Officer (LSO) and the LSS were reviewed. Assessment results are tracked in a database that is accessible on the Lab's intranet, and assessment findings are tracked to closure. Assessments are performed on a routine basis, are documented, and appear to be effective in helping ensure safe operations (NP-3).

Experiments at the FEL sometimes have a high turnover rate. The LSOP for each FEL covers the facility's operation up until the beam is available for the different experiments. Each new experiment is covered by an Experiment Safety Approval Form (ESAF) which serves as an initial, pre-setup safety review. Prior to FEL beam

authorization, a final laser safety check is required per what amounts to be an FEL beam start-up procedure. Review of completed start-up procedures found that checkboxes requiring a final laser safety check were not checked (**OBS-3**). Upon further inquiry, it was evident that safety checks had been performed before experiment approval was granted, but these checks were not documented in accordance with the policy identified in Chapter 3130 of the Lab's Environment, Health, and Safety (EH&S) Manual. The procedure contains human factor issues that need to be addressed.

Laser Operations Site Conditions

Laser protective eyewear was observed at four different locations. Eyewear appeared to be in good condition. All eyewear was stored outside the labs, allowing the user to don the eyewear prior to entry. Of the spot-checks conducted, the eyewear present were determined to be adequate for the optical density and wavelength requirements specified in the applicable LSOP.

Eyewear inspections are performed as part of the biannual LSS inspections required by EH&S Manual 6410.

At the He-3 experimental lab, protective covers for the eyewear were stored with the eyewear; however, the eyewear was not stored inside the protective covers. It is recommended that eyewear be stored in protective covers, if available.

Lab personnel stated that there is a mandatory use of laser eyewear at the site; however, this could not be found in EH&S Manual 6410. The LSOPs that were reviewed required eye protection as follows:

- A-05-006-LSOP, when exposure to laser light is possible and during alignment
- A-04-003-LSOP, when the laser interlock shutter is open
- A-04-009-LSOP, if the laser is on and when laser is in lasing mode
- A-04-004-LSOP, when work is performed with open class 3b or greater

If the Lab wants to commit to the mandatory use of eyewear, it should revise EH&S Manual 6410, accordingly.

Section 4.3.4 of ANSI Z136.1-2000 recommends a key or coded switch for Class 3b lasers and makes it a requirement for Class 4 lasers. Also, "during periods of prolonged non-use (e.g., laser storage), the master switch shall be left in a disabled condition (key removed or equivalent)." During field visits, there were no Class 3b or 4 lasers in operation; however, most of them had a key in the master switch. The Lab should develop its own guidance for laser key control (**OBS-4**).

General housekeeping appeared adequate for systems that were setup for use.

Program Management

As required by the Lab's contract with DOE, the Necessary Standards and the Sufficient External Standards are listed in the Lab's EH&S Manual. ANSI Standard Z136.1-2000, "Safe Use of Lasers," is listed as a Sufficient External Standard in EH&S Manual 2410.

LSO, LSS, and laser user responsibilities are listed in EH&S Manual 2410. The manual defines the LSO verbatim from ANSI Z136.1-2000, except that the word "authority" is missing. However, given the LSO responsibilities listed in the manual, one can deduce that authority is vested in the LSO. The LSO is designated by upper Lab management by name via EH&S 2210, "EH&S Responsibilities of Individuals."

The LSO has been performing "LSO-like" duties for approximately 12 years, including instruction of initial laser safety orientation, and is competent in the position. However, formal LSO certification has not been completed (OBS-5).

As previously mentioned, line self-assessments are performed on a routine basis, are documented, and appear to be effective in helping ensure safe operations.

LSOPs are numbered and tracked. Each LSOP is approved by the LSS, department/group head, and, finally, the LSO. LSOPs identify engineering and administrative controls, nominal hazard zones, optical densities, maximum permissible exposures, personal protective equipment, etc.

EH&S Manual 6410, Appendix 6410-T3, administers LSOPs and provides requirements that "must" be contained in LSOPs. Three LSOPs were reviewed to determine if they contained information required by Appendix 6410-T3 and, for the most part, they did. Out of 30 requirements, PHY-05-003-LSOP did not have requirements regarding clothing (no jewelry, etc.), room lighting conditions, and non-beam hazards. A-05-003-LSOP did not address non-beam hazards and the location of the laser operating manuals. A-04-009-LSOP did not have requirements for jewelry, room lighting, and operating manual location (though it did mention the manual). These observations are similar to OBS-2. Another documented observation is not warranted.

The Lab has begun a "Laser Safety Roundtable" that consists of each LSS and the LSO. This is similar to the Laser Safety Committee discussed in Appendix D3 of ANSI Z136.1-2000. The advent of the "Roundtable" is a positive indicator of the Lab's commitment to safety. This group can help with standardization, lessons learned, communication, continuity, best management practices, etc., regarding laser safety. However, the "Roundtable" has met roughly twice in the last two years, is basically ad hoc, and is not formalized. The Lab should have an "official" Laser Safety Committee that meets more frequently (OBS-6).

The Lab provided examples of efforts that have been made to reduce laser classification and subsequent hazards (NP-4). Laser hazards should be reduced or eliminated, when possible.

Lastly, procurement controls are warranted for laser system acquisitions, as to facilitate the LSO's advanced approval, and receipt inspection of these devices (OBS-7).

3.2 Conclusion

The Lab has a functional Laser Safety Program. Lab personnel displayed positive attitudes in regards to safety, and there were no programmatic breakdowns observed in the administration of the Laser Safety Program.

4.0 FINDINGS, OBSERVATIONS, AND NOTEWORTHY PRACTICES

4.1 Findings

None

4.2 Observations

(Note: At the request of TJSO, an attempt is made to rank these observations by importance.)

- 4.2.1 **OBS-2** The Lab should consider additional standardization (using best management practices of each LSS) for laser-specific training and LSOPs, in general, to help preclude problems in the future.
- 4.2.2 **OBS-3** Review of completed start-up procedures found that checkboxes requiring a final laser safety check were not checked. The procedure contains human factor issues that need to be addressed. *(Upon further review it was found that the safety checks had been performed but were not documented via the procedure.)*
- 4.2.3 **OBS-1** The LSS should formally authorize laser users upon completion of required training.
- 4.2.4 **OBS-4** The Lab should develop its own guidance for laser key control.
- 4.2.5 **OBS-7** Procurement controls are warranted for laser system acquisitions, as to facilitate the LSO's advanced approval, and receipt inspection of these devices.
- 4.2.6 **OBS-6** The Lab should have an "official" Laser Safety Committee that meets more frequently.

4.2.7 **OBS-5** Formal LSO certification has not been completed. *(The LSO has been performing "LSO-like" duties for approximately 12 years, including instruction of initial laser safety orientation, and is competent in the position.)*

4.3 Noteworthy Practices

NP-1 Laser-specific training consists of reading the applicable LSOP and a walk-through by the LSS. The LSS at the FEL also administers a test to demonstrate user competency for the FEL operation.

NP-2 Entry into the FEL laboratories is via a card reader, and the card reader will not allow users to enter into FEL labs (in certain modes of operation) until all required training is complete.

NP-3 Assessment results are tracked in a database that is accessible on the Lab's intranet, and assessment findings are tracked to closure. Assessments are performed on a routine basis, are documented, and appear to be effective in helping ensure safe operations.

NP-4 The Lab provided examples of efforts that have been made to reduce laser classification and subsequent hazards.

Appendix A – Personnel Interviewed

- LSO
- Deputy Associate Director for the Lab's EH&S Division
- FEL LSS
- Injector Test Stand (ITS) LSS
- ITS Graduate Student (laser user)
- He-3 Graduate Students (2) (laser users)
- National Aeronautics and Space Administration Engineer (laser user)

Appendix B – Documents Reviewed

- Laser Inventory
- SAF 157 Course Detail for "Injector Laser User Training"
- SAF 153 Course Detail for "Compton Hall A Laser User Training"
- Training rosters for courses SAF 157, SAF 154, SAF 156, SAF 151, SAF 152, SAF 153, SAF 158, SAF 1150, SAF 115U, SAF DLE, SAF
- FEL ESAF #05-003, "Laser Effects & Vulnerability Engineering, Sensor Testing"
- FEL ESAF #05-005, "First Power, Imaging and Spectroscopy Experiments with THz Beam in Lab 3"
- FEL ESAF #03-001, "Vibrational Dynamics of Hydrogen Defects in Silicon"
- LSOP #A-05-006-LSOP, "Polarized Source Qualification"
- LSOP #A-04-003-LSOP, "ITS Laser Room: Qualification of Lasers and Optical Elements Used for the Nuclear Physics Program Polarized Electron Guns, and for Photocathode Research"
- LSOP #PHY-05-004-LSOP, "Class 2 Conversion of Prometheus Laser"
- LSOP #PHY-05-003-LSOP, "New Laser Building Next to the Counting House for Polarized He3 Target"
- LSOP #A-04-009-LSOP, "Hall A Compton Polarimeter"
- LSOP #A-05-003-LSOP, "Operation of the Coherent Antares Nd:YLF Laser to Drive the Photocathode for the IR Upgrade Accelerator"
- LSOP #A-05-001-LSOP, "User Lab 1 Operation in the IR Upgrade FEL Facility"
- Laser Safety Roundtable Meeting Minutes and Power Point Presentation
- EH&S Manual 6410, "Laser Safety"
- SAF 114, "Laser Safety Class," training outline
- SAF 114, "Laser Safety Class," viewgraphs
- Example of Course Completion Record of Laser Users
- Example of FEL-Specific Laser User Examination

Appendix C - Activity Observations

- FEL Control Room, Optics Control Room, Labs 1, 3, and 6
- Hall B
- ITS Laser Room
- He-3