Operational Safety Procedure (OSP)

For The

Laser Bay

At the

Texas Center for High Intensity Laser Science

Document Number TPW-D-0011-A

Texas Center for High Intensity Laser Science
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1. Introduction

The purpose of this document is to describe approved operational safety procedures (OSP) for the laser bay of the Texas Petawatt Laser Facility. These are in addition to the lab safety procedures and laser safety procedures provided by the University of Texas Environmental Health & Safety (UT EH&S) office and can be found on their website (http://www.utexas.edu/safety/ehs/index.php). This OSP will include laser bay access procedures for authorized visitors, system users and laser operators. The two aspects to this access we describe are safety and strict cleanroom protocol.

The Facility Manager, Mikael Martinez has a master copy of this document. Visitors, users and operators are authorized to access this area after reading and signing on the last page. Authorized Personnel can perform work in the Laser Bay in approved areas described below. Only Authorized Operators can work on the Petawatt laser table. A list of Responsible Individuals (RI's), important phone numbers and revision management can be found on the last page of this document. The OSP described in this document are in effect starting April 25th 2009.

2. System Overview

The Texas Petawatt Laser is a 150 J, 150 fs laser based on Optical Parametric Chirped Pulse Amplification (OPCPA) with mixed Nd:glass. This laser architecture has been well documented by the Technical Staff here at the Texas Center for High Intensity Laser Science. For the purposes of this document, the technical design details of the laser are left out. Any of the Responsible Individuals or Laser Operators can provide detailed technical documentation of the laser design upon request.

The laser system is housed in a 1,500 ft^2 cleanroom, which we call the Laser Bay. Inside the cleanroom most of the laser is installed on a 34 ft long optical table system. Timing electronics, camera monitors and control computers are mounted in a 19" rack unit. Additionally, a smaller Class 100 cleanroom is situated at the back of the lab. This secondary cleanroom is used for optical assembly and other work requiring a clean environment. A second laser table system is located opposite the Petawatt Laser. This table houses a vacuum chamber and beam tube that extends into the target area. Inside the chamber is a mirror used to focus light onto target. Below in Figure 1, you will see the general layout of the Laser Bay. Later in this document you will also find pictures of the main subsystems described here.

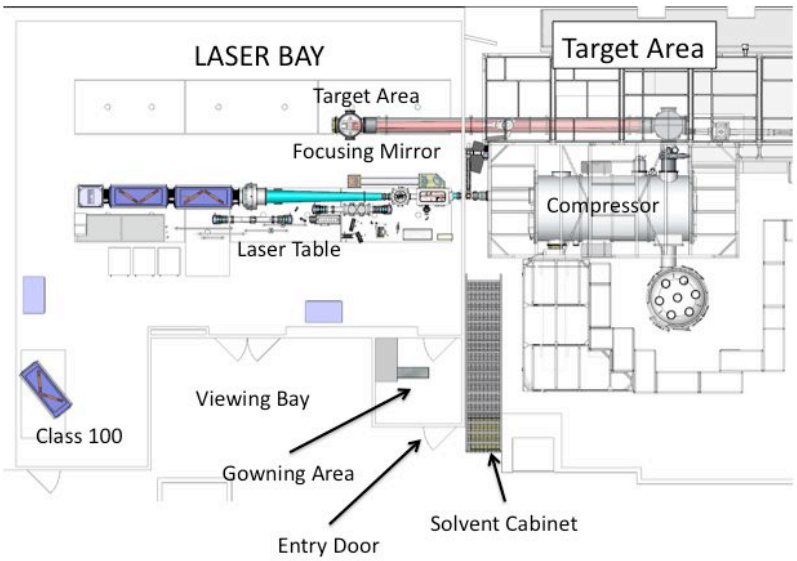

Figure 1. Layout of the Texas Petawatt Laser Bay.

3. Duties of the Responsible Individual (RI) and Authorized Personnel

- **Responsible Individual:** The RI is an authorized Laser Operator who is familiar with the details of running the laser system. The RI is responsible for ensuring authorized visitors and tour groups follow defined safety procedures and cleanroom protocol. The RI can issue stop work orders or deny access to anyone if he or she feels safety or cleanroom protocol is being compromised. Ted Borger (2-2174 or 2-2478) is the Responsible Individual for the Laser Bay. Alternate RI's and their contact information can be found at the end of this document if the primary cannot be located.

- **Laser Operator:** The Laser Operator is an individual who is authorized to perform work on the Petawatt laser (including the Compressor in the Target Area). The primary duties of the Laser Operator are to:
  - Start up the laser system.
  - Initiate Rod Shots.
  - Pump out and vent the Laser Bay & Compressor Vacuum sytems.
  - Bring laser light from the Laser Bay to the Target Bay.
  - Initiate System Shots.
  - Support Users with specific laser requests.

  NOTE: A separate OSP provides detailed Laser Operator instructions to perform these duties.

- **Authorized Personnel (AP):** Experimental staff and users who read and sign this OSP are AP's and agree to follow all procedures and protocol described below. AP's can work on their equipment or use the Class 100 cleanroom. The AP can only conduct tours of the Laser Bay with the escort of the RI.

4. Descriptions of Laser Bay Hazard:

The Laser Bay contains the following hazards.

- **Eye Hazard:** The laser system is a Class IV laser and can cause severe eye damage, skin burns and ignite flammable materials.
- **High Voltage Hazard:** Laser power supplies and the high voltage delivered from the Pulsed Power (see OSP TPW-D-0012-A) present a lethal electric shock hazard.
- **Hazardous Materials:** The following solvents are used in the Laser Bay: Acetone, Methanol, Isopropyl Alcohol, Ethanol, Nova Clean and Vacuum grease. Details of these hazards can be found in the OSHA MSDS sheets located in the document tray at the entrance to the Laser Bay. The surplus supply of these solvents must be stored in a yellow cabinet specially designed for flammable materials.

Eye hazards present in the laboratory are all Class IV lasers. The wavelength, energy and pulse duration are different depending on the subsystem of the laser. Below is a list of subsystem performance specifications and a figure of the laser table with the subsystems highlighted.

- **Oscillator:** >300mW @ 1057 nm
- **Oscillator Pump:** 10 W @ 532 nm
- **OPA:** >500 mJ @ 1057 nm
- **4J Pump**: 8J @ 1064 nm & 4J @ 532 nm
- **Rod Amplifier**: 20 J @ 1057 nm single shot
- **Main Amplifier Retro**: 75 J @ 1057 nm single shot
- **Main Amplifier Output**: 200 J @ 1057 nm single shot

Note: All Laser Bay subsystems described above are Class IV lasers.

Definition of Class IV laser:

Class IV

AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION

Class IV lasers include all lasers with beam power greater than class 3B. By definition, a class IV laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials, and thus may represent a fire risk. Class IV lasers must be equipped with a key switch and a safety interlock. Many industrial, scientific, military, and medical lasers are in this category.

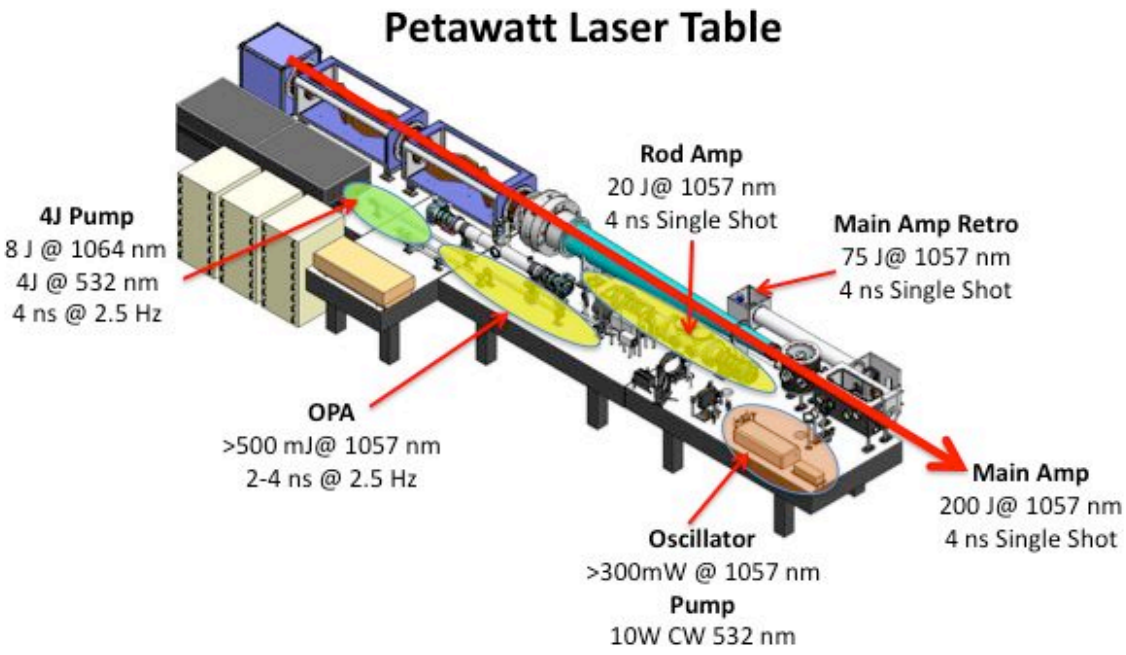

Figure 2. Laser light levels at different locations of the laser table.

5. Laser Bay Operation Modes:

The Texas Petawatt Laser Bay will be set into 5 different modes that are described below. Refer back to Section 3 for the laser hazard levels for the different subsystems described.

- **ALL CLEAR:** All Class IV lasers are powered down. In this mode there will be a Class I laser. This is the Oscillator with a shutter closed at the output. There is no eye hazard present.
- **WARM UP:** In this mode, all of the laser power supplies are powered up, however the shutters are in the closed position. Flashlamps on the 4 J pump laser are firing. There is no eye hazard present.
- **LASER ON:** In this mode, the shutters are open activating the OPA (4J 532 nm, 500 mJ 1057 nm @ 2.5 Hz). This Class IV laser eye hazard is now present in the Laser Bay. All personnel must wear protective laser glasses.
- **ROD SHOT:** The LASER ON mode is activated and the system is configured to initiate a Rod Shot, which amplifies the OPA to 20 J. The shot sequence will charge the rod amplifier capacitor banks and a fire

command triggers the flashlamps. This operation mode is single shot. Protective laser glasses are required.

- **SYSTEM SHOT:** The LASER ON mode is activated. This shot sequence charges the capacitors for both the rod amplifier and main amplifier. A fire command triggers the flashlamps in both subsystems to fire. The OPA is amplified from 500 mJ to the full 200 J output. In this configuration, all personnel must exit the Laser Bay. Personnel sweep and interlock procedures are performed prior to a System Shot.

6. Hazard Status Indication

All AP's and RI's must know how to determine what laser eye hazards are present in the Laser Bay. Due to the size of the laser it is unavoidable that laser eye hazards are present at or near eye level throughout the Laser Bay. Assume that High Voltage Hazards and Hazardous Materials are always present in the area.

Distributed throughout the facility are Interlock Status Panels (ISP's). These panels indicate what hazards are present in all areas of the facility. See OSP-TPW-D-0012 Pulsed Power and TPW-D-0013 Target Bay for descriptions of the ISP for those areas. The locations of the ISP panels can be found in the figure below:

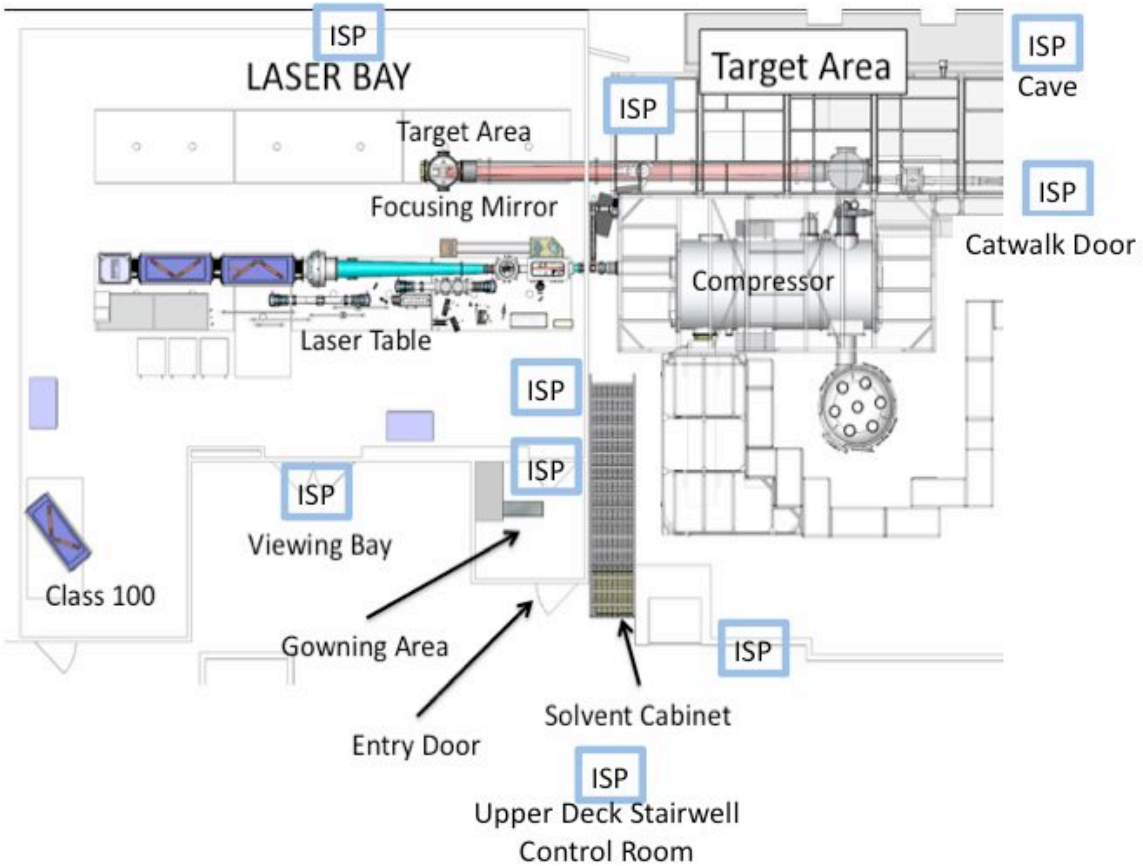

Figure 3. Interlock Status Panel (ISP) locations throughout the facility communicate hazards present.

Below in Figure 4, is a screen shot of the status panel showing ALL CLEAR.

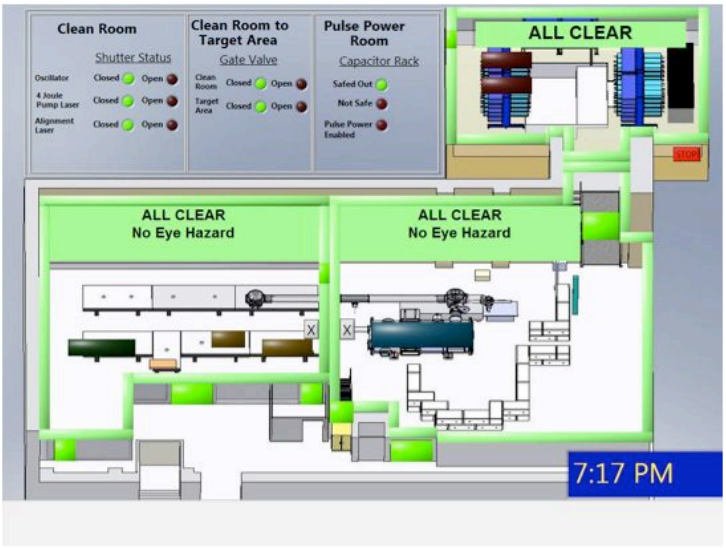

Figure 4. Status panel for indicating ALL CLEAR.

The next operation mode for the Laser Bay is WARMUP mode. The status panel for this mode is shown below.

Figure 5. Status panel configuration for indicating the laser is in WARMUP mode.

The third mode of operation is LASER ON mode. This is shown below. Notice the boxes labeled 4J pump laser, Oscillator and CW Alignment. These represent the laser subsystems and will be blinking when their shutters are open.

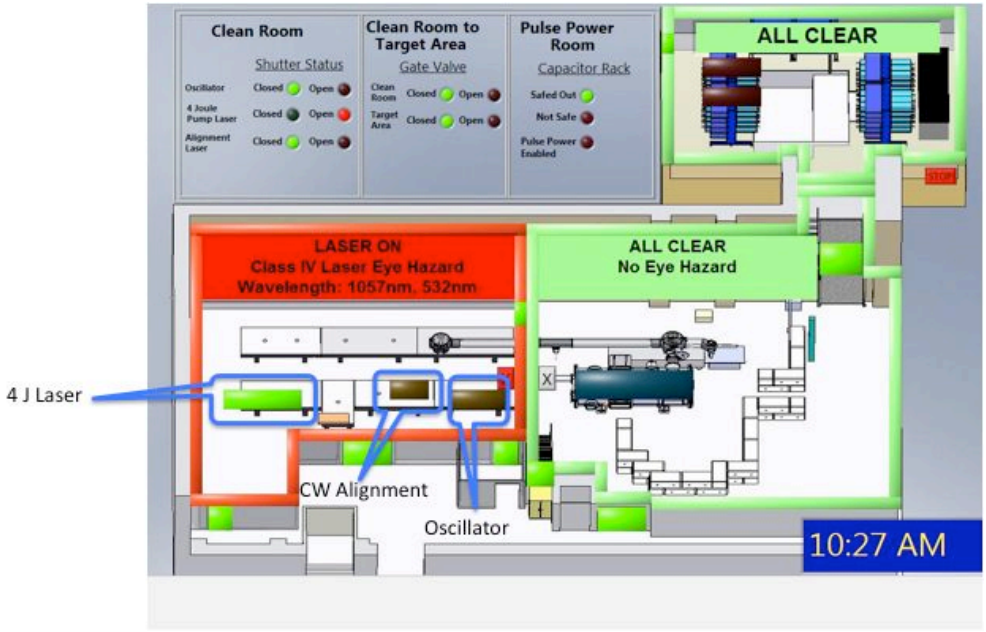

Figure 6. LASER ON mode with blinking indicators show which laser shutter is open.

The ROD SHOT mode is shown below. Note that there is a ROD AMP CHARGING indicator. This will be blinking while a Rod Shot is in progress.

NOTE: When a rod shot is not progress, the ROD AMP CHARGING blinking indicator will not be present on the screen.

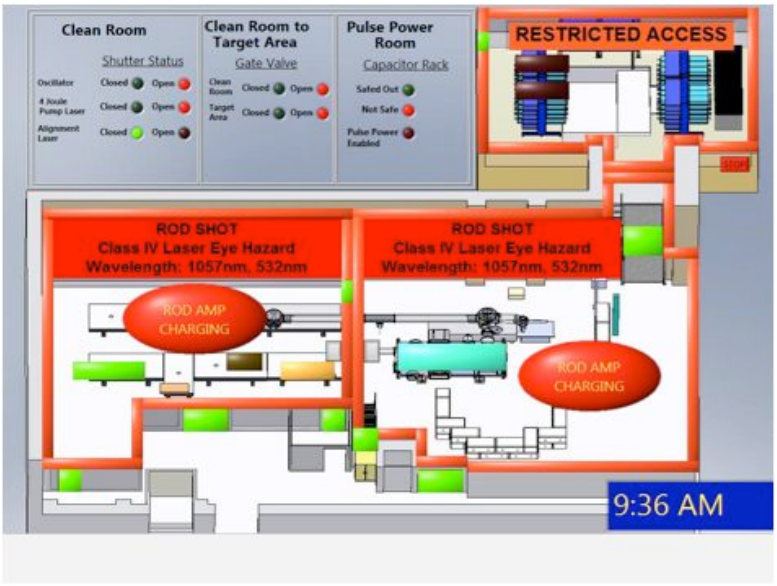

Figure 7. ROD SHOT status panel and blinking CHARGE indicator show a rod shot in progress.

The final mode of operation in the Laser Bay is SYSTEM SHOT mode. Below is the status panel for that mode.

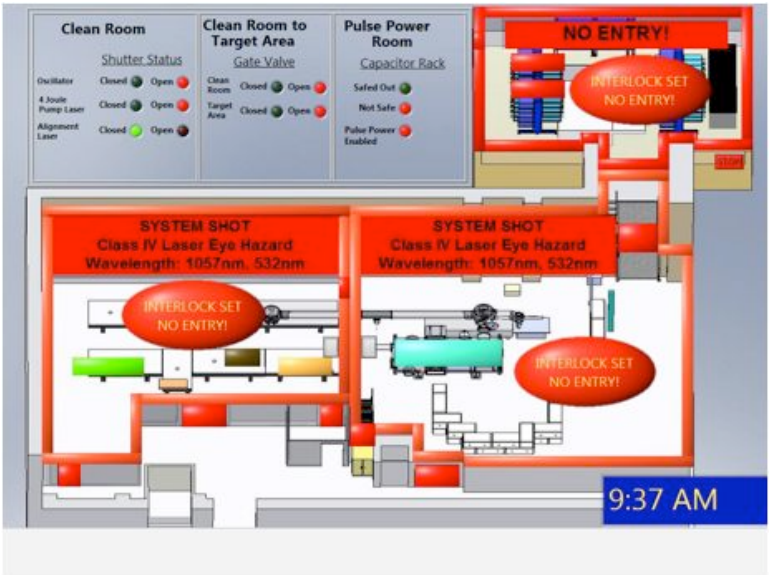

Figure 8. Status panel shows all interlocks set for full system shot.

7. Accessing the Laser Bay

All AP's, and escorted guests must wear appropriate laser safety glasses at all times independent of ISP and warning light configurations.

NOTE: PERSONNEL ARE NOT ALLOWED TO ENTER THE LASER BAY WHILE IN THE FOLLOWING MODES:

- **DURING A ROD SHOT CHARGE & FIRE SEQUENCE**
- **SYSTEM SHOT MODE**

There are two main considerations we will discuss for access to the area. First is safety and second is cleanliness. We have defined specific procedures for access or work to be done in the Laser Bay. Below is a list of steps required to enter the cleanroom:

7.1.1 General Access

General access is for entering the Laser Bay only. Additional procedures follow for work to be done and access to the Class 100 cleanroom.

- View an ISP either over the viewing window of the cleanroom or in the gowning room and determine the level of laser hazard. Figure 9 below shows a photo of the viewing area ISP location.

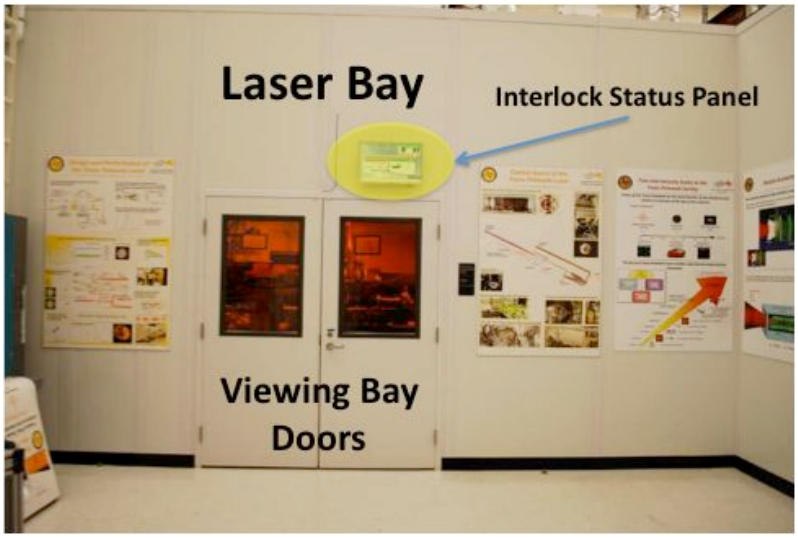

Figure 9. Photo of Laser Bay Viewing Area with ISP location.

- Enter the gowning area. Below is a photo of what you will see in the gowning area with ISP panel, laser glasses case and laser warning indicator light.

Figure 10. Photo of gowning area

- Once inside the gowning area, put on cleanroom garments in the following order:
  - Booties
  - Frock
- Wipe down any parts being brought into the cleanroom with the solvents and wipes provided in the gowning area on the yellow bookshelf.
- Put on laser glasses. The (brown) glasses in this case will protect all wavelengths present.
- Enter the cleanroom closing the door behind you (it is not spring loaded and can swing back open).

- Find the laser operator or RI and announce you are in the lab.

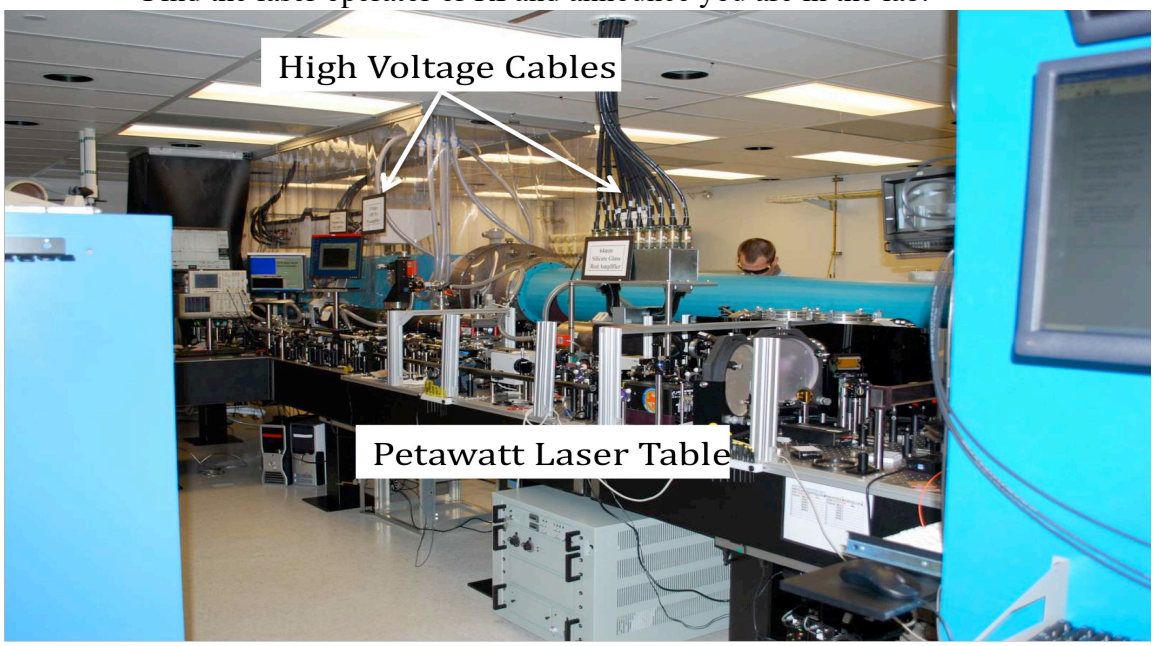

Figure 11. Photo of Laser Bay just inside entry door.

7.1.2 Work To Be Done

This section describes the process to enter the Laser Bay and perform work.

- Meet with the Laser Operator or RI to let them know you plan to do work in the cleanroom.
- Follow General Access procedures 6.1.1.

7.1.3 Work in Class 100 clean room:

The Class 100 cleanroom is available for use by AP's including outside users and local experimental staff. Procedures to begin work in this area are listed below.

- Meet with the Laser Operator or RI to request access to the Class 100 cleanroom.
- Follow both the General Access and Work To Be Done procedures above.
- At the entrance to the Class 100 clean room wear the additional cleanroom garments in the following order:
    - Mask
    - Hood
    - Double Gloves. This allows better protection and it is easier to replace the outer pair as necessary.

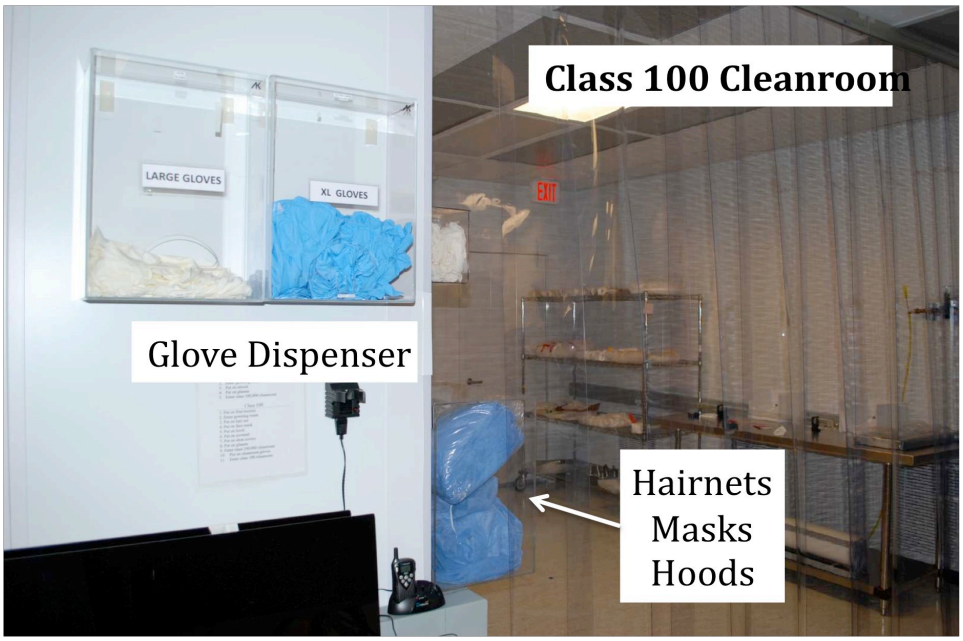

Figure 12. Photo of Class 100 Cleanroom and garment location.

NOTE: Do not use Acetone while wearing Nitril or Latex gloves. Polyethylene (PETE) gloves are required when using acetone.

NOTE: Approved work surfaces are the two clean benches.

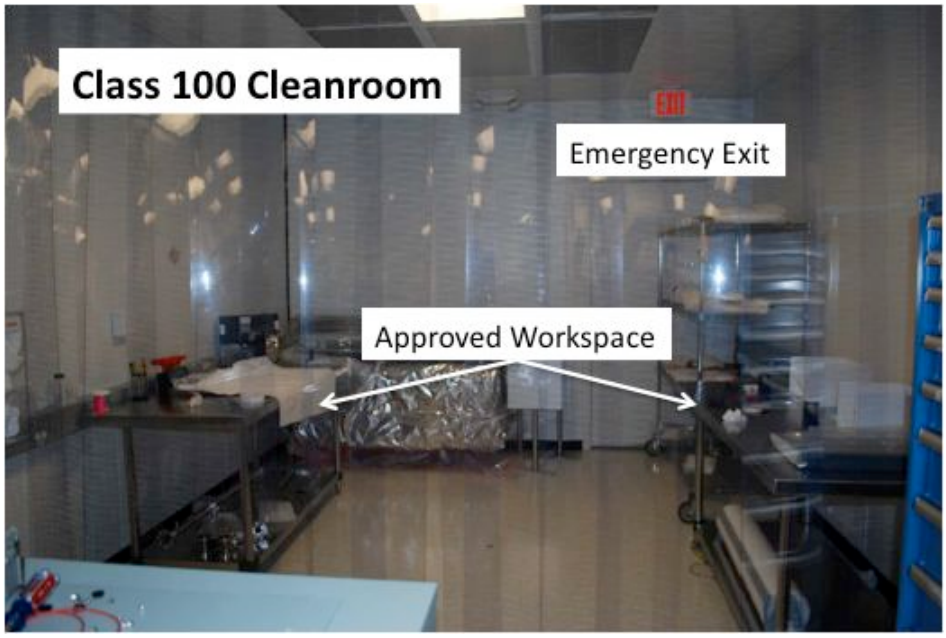

Figure 13. Photo of Class 100 Cleanroom with approved workspace

7.1.4 Access to the Compressor Cleanroom

Laser Bay RI and Laser Operators control access to the compressor cleanroom and the diagnostic table. Special requests for access to these areas have to be approved by the RI and Laser Operator. The following procedure describes access to this cleanroom.

- Entry will be through the Laser Bay
- Follow procedures for General Access 6.1.1 and Work to be Done 6.1.2
- Put on a hair net and mask, gloves and hood in the gowning area
- Enter the Target Area door at the Laser Bay
- Enter the compressor clean room

8. Contact List

Below is a list of RI's and alternates as well as other important contacts:

Responsible Individual (RI)	**Phone Number**
Ted Borger	232-2174
Alternate Mikael Martinez	471-5648
Alternate Erhard Gaul	471-1803
Laser Bay Phone	232-2478
Control Room Phone	232-2174

Emergency Contacts	**Phone Number**
UTPD Emergency including fire or medical	471-4441
Mikael Martinez Cell	512-554-1309
Ted Borger Cell	925-518-6833
Erhard Gaul Cell	512-784-4583

Important Phone Numbers	**Phone Number**
Laser Bay Phone	232-2478
Control Room Phone	232-2174
Todd Ditmire	471-3296 512-762-5065 (C)
Mikael Martinez Cell	512-554-1309
Ted Borger Cell	925-518-6833
Erhard Gaul Cell	512-784-4583
Mechanical Engineering	232-3533
Maria Aguirre	471-5648
	232-2465

9. OSP Signature

This signature section indicates that you have read and understand the procedures and hazards described in this document.

Name	Signature	Date

10. OSP Revision History

Revision History					
Rev	**Description**	**Author**	**Reviewed By**	**Approved By**	**Date**
A	Initial Release	M. Martinez	E. Gaul T. Borger	T. Ditmire	May 11 2009