

Texas Petawatt Laser User Program Standing Operating Procedures (SOP)

Version 4, Updated July 21, 2011

1. Introduction and Scope

- a. Purpose of the User Program SOP: This SOP establishes the policies that govern the User Program on the Texas Petawatt Laser. It is written as a guide for both internal and external researchers as well as for the Petawatt Oversight Committee and Texas Petawatt Laser staff.
- b. The Texas Petawatt Laser (TPW): A general description of Texas Petawatt Laser capabilities is given in Appendix A. Light can be delivered to either of two target chambers in a variety of forms as outlined in Appendix B.
- c. Objectives of the CHEDS and TPW: The University of Texas at Austin's Center for High Energy Density Science (CHEDS) is operated under a cooperative agreement with the NNSA with the following missions:
 - Conduct research in laser driven HED science and shocked materials science and attract new students into these areas
 - Train US citizen graduate students in these two areas
 - Train students in how to plan and execute experiments on large scale HED facilities
 - Develop novel and "high risk" HED diagnostics that could ultimately be fielded on the large HED facilities (NIF, Z, and Omega)
 - Collaborate on many experiments with National Laboratory scientists to remain coupled to the labs and to expose students to the activities of the labs
 - Partner with the NNSA labs on technical projects and some facilities development
 - Leverage existing efforts at UT in allied fields.

The User Program on the Texas Petawatt Laser is designed to efficiently support a number of these missions. It applies to researchers from UT Austin, other universities, NNSA laboratories, and potentially other HED science researchers.

- d. Purpose of the User Program: The TPW is a multimillion dollar research facility at the cutting edge of technology. It is funded by the taxpayers of the United States and the State of Texas to support national security, to advance fundamental science, and to educate the next generation of high energy density scientists. We take this public trust very seriously.

The TPW shot rate is limited by the physical properties of the laser gain medium to no greater than one shot per hour, making efficiency of operations of prime importance. To achieve this efficiency, the experiments on the TPW must be well planned and ready to execute when scheduled. They must be well coordinated with laser maintenance and laser improvement activities. The User Program is intended to ensure that we meet these imperatives.

A wise selection of experiments and a schedule that maximizes the collective scientific output are likewise important elements of maximizing the investment in the TPW. The Petawatt Oversight Committee, established as part of the User Program, provides a structure that seeks this end.

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3. Requesting shot time on the TPW

- a. A researcher interested in conducting an experiment on the Texas Petawatt Laser should contact one of the following three points of contact:
 - Dr. Mike Donovan, (mdonovan@physics.utexas.edu, 512-475-7956)
 - Mr. Mikael Martinez (mikaelm@physics.utexas.edu, 512-471-5648)
 - Prof. Todd Ditmire (tditmire@physics.utexas.edu, 512-471-3296).
- b. This person will help the interested party determine if the TPW is an appropriate experimental platform for the proposed experiment.
- c. If so, the researcher will send a formal request for TPW shot time using the format of Appendix C; this request will be reviewed at the next quarterly Petawatt Oversight Committee meeting for selection and scheduling. This format can also be found on our website at <http://texaspetawatt.ph.utexas.edu>.

- d. Most research on the TPW will be collaborative with the University of Texas at Austin, Center for High Energy Density Science (CHEDS). This maximizes the potential for a successful experiment. The degree of collaboration will depend on the nature of the experiment.

4. Selection and scheduling of shot time on the TPW

- a. The Petawatt Oversight Committee (POC), described in the next section, is the selection authority for TPW experiments.
- b. The POC meets quarterly (in March, June, September, and December) to select experiments to be conducted on the TPW and discuss the TPW experimental program. The POC will provide direction or advice, as the Committee feels appropriate, on when specific experiments should be scheduled, the order or priority of execution, and any other matters concerning the experimental content of the TPW schedule.
- c. Experiments will be scheduled considering experimental team availability, preparation time required, availability of required or useful resources, and efficiency of operations regarding sequencing. Generally an experiment will be scheduled a minimum of six months in advance to enable the full sequence of reviews.

5. TPW Governance and the Petawatt Oversight Committee (POC)

- a. POC membership will generally include the following people:
 - CHEDS Director
 - TPW Associate Director
 - TPW Chief of Engineering and Science
 - Two to four CHEDS faculty or staff researchers
 - One to three researchers from outside of the University of Texas.
- b. Responsibility and authority for TPW management decisions beyond selecting and scheduling the experimental program resides with the CHEDS Director and TPW Associate Director.
- c. The TPW Associate Director is responsible for scheduling and leading meetings of the POC.
- d. The POC shall decide on any changes to the Committee membership.

6. Principal Investigator, Experimental Team Leader, and TPW Staff Liaison Responsibilities

- a. For each experiment, a Principal Investigator (PI) and an Experimental Team Leader shall be identified. If the PI is not part of CHEDS, a TPW Staff Liaison shall also be identified.
- b. The PI will generally be the person identified as such in the "TPW Shot Request," but this can be changed with the mutual agreement of the new PI and the CHEDS Director.

- c. The PI is principally responsible for the overall management of the experiment or experimental campaign, to include experimental and theoretical aspects and the publication of results. The PI is accountable to the CHEDS Director for compliance with UT Austin requirements and complying with this SOP.
- d. The Experimental Team Leader, who may also be the PI, is the person identified by the PI to principally plan and execute the experimental effort. A graduate student may be the Experimental Team Leader, but will generally not be the PI.
- e. When required, the TPW Chief of Operations will identify a TPW Staff Liaison who will be the principal point-of-contact for TPW information and assistance. The TPW Staff Liaison will take an active role in ensuring that all of the preparations necessary to have a successful collaborative experiment are occurring in a professional and timely manner.

7. Meetings in preparation for TPW Experiments

- a. Three meetings are required for every TPW experiment: (1) an Initial Experimental Planning Meeting, (2) an Intermediate Readiness Review, and (3) a Final Readiness Review. Each will be planned for one and a half hours. Other planning and coordination meetings can be held if necessary.
- b. Initial Experimental Planning Meeting
 - Approximately six months prior to an experiment, the PI or designated representative will present his or her experimental plan to the CHEDS staff to coordinate experimental planning and preparation.
 - The format for this plan is found on the Texas Petawatt User Program website <http://texaspetawatt.ph.utexas.edu>.
 - CHEDS staff present will generally include the Director and/or an Associate Director, the TPW Chief of Engineering and Science, the TPW Chief of Operations, the TPW Staff Liaison for the experiment, and CHEDS personnel that expect to be engaged in the experiment.
 - The Experimental Team Leader (who might also be the PI) should be present, as well as other people engaged in the experiment
 - Either this meeting or the Intermediate Readiness Review (or both) should be at the University of Texas at Austin unless the experimenters are familiar with the Texas Petawatt Laser. The meeting can also be by video- or teleconference.
- c. Intermediate Readiness Review
 - The Intermediate Readiness Review will be held approximately three months before the start of the experiment.
 - The PI or a designated representative will update information presented in the Initial Experimental Planning Meeting, and will add additional information which is listed on

the TPW User Program website (comprehensive list of equipment and supplies needed, status of meeting safety and Visiting Scientist requirements, status of diagnostic development and testing, detailed shot plan, travel plans)

- This meeting can be in person, by video or teleconference, or by a combination.
- Attendees are the same as for the Initial Planning Meeting.

d. Final Readiness Review

- The Final Readiness Review will be two to four weeks prior to the start of the experiment.
- The PI or designated representative will update all information from the Intermediate Readiness Review, with emphasis on shot planning and the status of equipment required for the experiment.
- This meeting can be in person, by video or teleconference, or by a combination.
- Attendees are the same as for the Initial Planning Meeting.

8. User equipment from home station

a. Equipment delivery timeline: All experimental hardware including diagnostics, instruments, targets, gases and tools should be delivered to the TPW NLT seven days before your run.

b. Delivery address

2511 Speedway St. RLM 12.204
Austin, TX 78712
Attn: Maria Aguirre

c. Loading dock access: For large crates and deliveries, there is a truck height loading dock for your use.

d. Freight elevator access: The TPW has freight elevator access to the experimental area. The dimensions of the elevator are 13' x 6.5' x 8'.

e. Resources: Pallet jacks, electronic lifters and furniture dollies are all available.

9. UT hosting of TPW users

a. Travel Logistics.

- Local Airport info:

Airport: Austin Bergstrom International Airport (AUS)
<http://www.ci.austin.tx.us/austinairport/>

- Location of CHEDS and TPW

We are located in Robert Lee Moore Hall (RLM). A link to the campus map is on the website (User Info, User Logistics). Initially go to the 12th floor room 12.204 and see Maria Aguirre (512-471-3274).

2511 Speedway RLM 12.204
Austin, TX 78712

- Accommodations (see also Austin Hotels Link on website)
 - On Campus AT&T Center (\$150): www.meetatatexas.com
1900 University Avenue Austin, TX 78705, United States
512 404 1900
 - Double Tree (\$100): doubletree.hilton.com
1617 IH-35 North
Austin, TX 78702, United States
512 479 4000
 - Roadway Inn (\$70): www.rodewayinn.com
2900 North I-35
Austin, TX 78705-3404, United States
512 477 6395
 - Days Inn (\$60): www.daysinn.com
3105 N Interstate 35,
Austin, TX, 78722, United States
866 539 0036
 - Extended Stay America (\$100): www.extendedstayamerica.com
600 Guadalupe Street
Austin, TX 78701, United States
512 457 9994
 - Super 8 (\$50): www.super8.com
1201 North I-35
Austin, TX 78702, United States
512 472 8331
- Transportation
 - Enterprise Car Rentals
1201 West 5th
AUSTIN, TX 78703-5204
512 476 2300
 - Yellow Cab Austin
<http://www.yellowcabaustin.com/?gclid=CJDjp5D-qKkCFYru7QodFnIwIQ>
512 452 9999
 - Capitol Metro Airport Flyer
http://www.capmetro.org/riding/current_schedules/MAPS/RT100_SB.PDF
512 474 1200
- Parking on campus
 - Parking is very limited on the UT campus, but there are several options. Free on-the-street parking is available on Dean Keeton Street, but usually fills up by 6:30-7:00 AM. From some locations, there are city buses (ask your hotel). The Speedway Garage and San Jacinto Garage are both fairly close, but cost \$12 per day. You can park at the loading dock for 30 minutes for unloading equipment. Finally, as an appointed visiting scientist or visiting student you are eligible to purchase an "A" permit for the balance of the academic year, which may or may not be cost effective.
 - On campus parking map:
<http://www.utexas.edu/parking/maps/map.htm>
 - "A" Pass parking permit instructions:

<http://www.utexas.edu/parking/parking/fs/a.html>

b. Orientation. Prior to the 3 month readiness review, Users must complete the following steps for registration, training and onsite internet access:

- **UT EID registration**
This is an employee number given to the user and is used to track training and status of the user. Setup your UT EID at the following address:
https://idmanager.its.utexas.edu/eid_self_help/
- **Appointment as a Visiting Researcher or Undergraduate**
In order to work without escort in the facility, the University requires the User to be registered as an official Visiting Researcher or Visiting Undergraduate. In both cases, the user starts the process by submitting a filled out background check authorization form, a current CV, and (if not a US citizen) a copy of a valid passport. Once UT has processed these documents, an official offer letter is generated. The user must sign and return the letter for the final approval process to begin. This final approval typically takes four weeks. Information and forms can be found at:
<http://www.utexas.edu/hr/manager/hiring/HowtoRequestaCriminalBackgroundCheck.html>
- **Training**. After a UT EID is registered, the User must complete the following online safety training classes: <http://www.utexas.edu/safety/ehs/train/> and then click on these courses: OH-101, OH-102, OH-201, OH-202, OH-301, OH-304, OH-306

c. Administrative. The following administrative services are available to users:

- **Wireless internet connection**. The TPW has guest wireless access in the Facility. Two weeks prior to the run, users should request a user ID and password for internet access. Please contact Maria Aguirre at 512-471-3274 or maria.aguirre@mail.utexas.edu.
- **Office space**. Office Space is limited to the control room only. This is an active area during experimental campaigns. Executing laser shots and internal meetings can temporarily limit the Users access.
- **Scanning/copies/faxes**. A scanner, copier and fax machine are available to the User. The services are located on the 12th floor in room 12.204.
- **Computers/software**. Users should bring computers for their use as needed. Special requests for computers and /or software will be addressed on a case-by-case basis.

d. Contact List. A contact phone list can be found posted in the control room. Relevant labs and personnel are listed.

e. Support Capabilities. The following support capabilities are available to the User in preparation for or during the run:

- Student Machine Shop. Researchers have access to the following machines after an initial orientation and sign off with the shop supervisor:
 - (6) vertical mills with digital readouts
 - (4) lathes
 - Band saw
 - Glass-bead blasting hood
 - Drum sander
 - Arbor press
 - Sheet metal shear (48" width, max. thickness = 1/8" Al)

Equipment provided by the student machine shop:

- Table clamps
- Parallels
- Basic hand tools
- Lathe cutters
- Outside micrometers
- Edge finders
- Small pieces of SST, Al, & plastics

Not provided by the shop:

- Safety glasses (required)
- Drill bits (TPW has a small assortment of standard sizes)
- End mills (TPW has a small assortment of standard sizes)
- Taps (TPW has a small assortment of standard sizes)
- Large pieces of material
- Professional Machine Shop. Small work orders can potentially be submitted to the professional machine shop. Please go through the TPW mechanical engineering department if you want to pursue this option. Typical lead time for prioritized work is 1-4 weeks.
 - Full-time machinists
 - CNC mills
 - Machining stations each with a manual mill and lathe
 - Welding shop
 - Horizontal band saw
 - Large sheet metal shear (8' length)
 - Arbor & hydraulic presses
- A work station with a limited assortment of general tools, soldering irons, and crimp/cut/strip tools is available in the TPW high bay.

10. Training required for a TPW user

a. University requirements

Refer to section 9 b for a list of University training requirements.

b. TPW Training

Prior to the experimental run, the User must read various safety documents and procedures specific to hazard areas in the facility. Once read, the User will be tested and cleared for access to that area. All experimenters must read the following documents as a prerequisite for being cleared.

- TPW-D-0011-A Operational Safety Procedure for the Laser Bay
- TPW-D-0012-B Operational Safety Procedure for the High Voltage Pulsed Power
- TPW-D-0013-B Standard Operating Procedure for the Target Bay

11. Operations of the TPW during experiments

a. Plan of the Day Meeting

- A Plan of the Day (POD) meeting will be held at 9:00 AM in the Control Room on every shot day.
- The experimental team will update the TPW staff on experimental progress and any changes needed to shot execution.
- The TPW Laser Operator will update the experimental team on laser performance and any issues.
- This meeting should last 15 minutes or less.

b. Laser operator

- The laser operator has primary responsibility for safe operation of the TPW and for laser pulse diagnostic data collection.
- The laser operator will ensure that someone has warmed up the system so that it is ready before the first projected shot (usually 9:15 AM).
- The laser operator will provide information and direction over a public address system from the Control Room and from the TPW clean room. These announcements are generally to ensure that everyone in the facility is aware of the laser status, and evacuates when required for laser operation.
- The laser operator has authority over activities in the Control Room during laser operations.
- Experimenters should communicate with the Laser Operator on any safety concerns and on anything concerning the operating of the TPW.

c. Conduct of experiments

- Experimental shots will be performed between 9:00 AM and 6:00 PM on weekdays.
- The maximum shot rate of the TPW is 1 shot/hour at full energy. Higher shot rates at lower energies can be achieved. Refer to our website <http://texaspetawatt.ph.utexas.edu> for a detailed description of the laser performance.
- In many situations, the experimental team can improve data collection by making equipment adjustments and analyzing data outside of the shot day.

d. Communications

Local communications in the facility is primarily done with local radios between the Experimenter, TPW Staff, and the Shot Director. Additional communication methods are phone communications and a facility Public Address (PA) system.

e. Laser performance data collection, processing, and distribution. After each shot, the experimenter will receive a shot summary, which includes:

- Shot Number
- Energy on target
- Pulse duration
- Focal spot
- Spectrum

A more detailed shot report with raw data can also be provided for additional analysis.

f. Safety. The TPW Facility maintains a number of Operational Safety Procedures for safe access to the facility. Personnel and equipment safety SOP's are strictly adhered to. Please refer the website <http://texaspetawatt.ph.utexas.edu> for a detailed description of our safety documents and procedures for access to the laboratory.

g. Adjustments. Over the course of the experiment, laser parameters or experimental results may redirect the shot plan presented to the TPW staff. We encourage the User to modify the shot plan to optimize their time on the laser system. The User can request a shot plan change to the Shot Director.

12. Experimental data collection and management

- a. Computers for data collection and processing. When appropriate, some TPW computers are available to users for data acquisition. These are typically connected to our LAN and can be accessed from any computer via Remote Desktop.
- b. Transferring data to users, if necessary. If experimental data is taken with a TPW computer and/or diagnostic, the data will be transferred to the user from our data base.
- c. Data file numbering to match laser performance data. Post shot, the official shot number will be included in the shot summary detailed above in section 11 e.

13. Response to laser down time and experimental issues. Experiments are generally scheduled six or more months in advance along with a minimum of down time for laser maintenance and upgrades. The TPW facility is not sufficiently staffed to extend the shot week beyond five days or to extend the shot day beyond the usual nine hours of operations preceded by two hours of warming up the system and

setting the deformable mirror. Thus the experimenters must anticipate how they will react to issues that affect the pace of the experiment within the allotted time.

Appendix A: Research opportunities on the TPW (As provided to the Omega Users Group)

Experimental System:

Texas Petawatt Laser

What is available:

- The Texas Petawatt Laser produces 170 fs pulses at a central wavelength of 1057 nm.
- The pulses can be amplified up to 190 J in an f/40 target chamber, limited by the damage threshold of the laser system
- The pulses can be amplified to 60 J in an f/3 target chamber, limited by damage threshold of the final focusing parabolic mirror. With the installation of a dielectric high reflective coated final focusing mirror in December 2011, the maximum pulse energy will be increased to 190 J.
- At full power, the repetition rate is one shot per hour
- The Texas Petawatt Laser can be operated at a higher repetition rate with lower levels of amplification: 4 shots per hour at 7 J, or 2.5 Hz at ~100 mJ
- Pulse focus is near twice the diffraction limit
- Experimental runs are typically three weeks in duration

Location:

The University of Texas at Austin

How to get time:

Contact Mike Donovan (mdonovan@physics.utexas.edu), Mikael Martinez (mikaelm@physics.utexas.edu), or Todd Ditmire (tditmire@physics.utexas.edu) if you are interested in research on the Texas Petawatt Laser. The Petawatt Oversight Committee considers and schedules new experiments every three months.

Website:

<http://texaspetawatt.ph.utexas.edu>

Administrative Contact:

Maria Aguirre, maria.aguirre@mail.utexas.edu, (512) 471-3274

Student /Postdoc Contacts:

Mike Donovan, mdonovan@physics.utexas.edu, (512) 475-7956

Mikael Martinez, (mikaelm@physics.utexas.edu, (512) 471-5648

Appendix B: Operating modes of the Texas Petawatt Laser

The Texas Petawatt Laser offers users a selectable set of laser parameters available on target. There are four main categories for delivering light to multiple target chambers.

CW Alignment Light: This is a diode pumped, CW, Nd:YVO₄ laser. The laser outputs around 4 W however, due to losses in the system, 100 mW can be expected on target. At the user's request, we can reduce the power level as well.

The CW laser is narrow band and centered at 1064 nm. It is injected into the laser chain before the 2nd Optical Parametric Amplifier stage. This light is collinear with the main laser pulse and is ideally suited for target alignment as well as diagnostic commissioning.

Injection of the CW laser is straightforward. We can provide this class of light to the target chamber at any time including between shots if requested.

Optical Parametric Amplification (OPA) Shots: The OPA section of the laser typically amplifies the seed to around 500 mJ. The user can request OPA on target. At target, one can expect 100 mJ and compressed to 135 fs. This pulse is broadband (25 nm). The user can request OPA shots on target anywhere from single shot to 2.5Hz continuously.

This class of light also can be delivered to either target chamber at anytime, including in between shots.

Rod Shots: Upon request, rod shots can be delivered to target. The maximum energy that can be delivered to target is 7 J, compressed to 170 fs. If requested, rod shot energies could be reduced and pulse durations stretched. This subsystem operates single shot with a shot available every 15 minutes. The maximum shot count for a Rod Shot only run would be 30 shots per day.

System Shots: System Shots are our full energy shots which deliver >1 PW of peak power to the target. The maximum energy delivered to target is 190 J compressed to 170 fs. The user can request shots down to 50 J. Additionally if requested, the pulse duration can be stretched to the ps range. The shot rate for System Shot is one shot every hour. The maximum daily shot count is seven shots.

Below is a table, which describes the 4 main classes of laser light and focusing geometries available to the user.

	CW	OPA	Rod Shots	System Shots
Rep Rate	CW	Single Shot to 2.5Hz	every 15 minutes	once an hour
Energy/Power on target	500mW	100mJ	7 J	Up to 190 J
Spot Size at TC1	5 μ m	5 μ m	5 μ m	5 μ m
Spot Size at TC2	100 μ m	100 μ m	100 μ m	100 μ m
Pulse Duration	N/A	135fs	170fs	170fs
Total number of shots per day	N/A	N/A	30	7

Appendix C: TPW Shot Request Format

This is a format for requesting Texas Petawatt Laser (TPW) time. Prospective Principal Investigators will submit this shot request to mikaelm@physics.utexas.edu and mdonovan@physics.utexas.edu. The TPW staff will analyze and organize this information for the Petawatt Oversight Committee (POC), who will select and schedule the experimental program. The shot request will typically be four to six pages, including figures.

1.0 Title

Give a title for the proposed experiment.

2.0 PI, Co-PI's & Affiliation

List the Principal Investigator, as well as any other staff that will be visiting during the run. Also, list the affiliations for the PI and other investigators.

3.0 Experimental Objectives and Concept

Explain in this section the scientific and technical objectives of the experiment (or campaign) and a narrative of how it will be conducted.

4.0 Diagram

Provide a general experimental layout and, if useful, a concept sketch that clarifies the science. Include which focusing geometry you require (f/40 or f/3) and the desired set of diagnostics. The TPW staff can assist on preparing this, (POC Erhard Gaul at gaul@physics.utexas.edu).

5.0 Your Estimate for Likelihood of Success and Scientific Impact

Briefly summarize the current state of experimental and theoretical understanding, and the impact of your work. Assess the challenges in making the experiment work.

6.0 Measurement Requirements and Equipment

Generate a list of measurement requirements and the equipment needed to support those measurements. Indicate whether the equipment needs to be supplied by the TPW facility or will be provide from your own resources. Identify any equipment that you would bring or conditions that you would create that require special safety considerations, such as chemicals, high voltage, and ionizing radiation.

7.0 Laser Performance Requirements

Pulse energy, pulse length, focal spot size, and any other pulse characteristics needed to execute the experiment. Include any requirements for limitations on shot-to-shot variation.

8.0 Time Estimate

Estimate the time needed to perform the experiment, including setup time and shot time.

9.0 Availability

Indicate your availability to perform the experiment. Include the earliest you can execute and any dates that you will not be available.