FY13 Laser Facility Report

During FY13, the Omega Laser Facility conducted 1408 target shots on the 60-beam OMEGA laser and 576 target shots on the four-beam OMEGA EP laser for a total of 1984 target shots (see Tables 136.V and 136.VI). OMEGA averaged 11.5 target shots per operating day with Availability and Experimental Effectiveness averages of 93.9% and 96.6%, respectively.

OMEGA EP was operated extensively in FY13 for a variety of internal and external users. Of the 576 total shots, 507 target shots were taken into the OMEGA EP target chamber and 69 joint target shots were delivered to the OMEGA target chamber. OMEGA EP averaged 6.7 target shots per operating day with Availability and Experimental Effectiveness averages of 93.8% and 93.7%, respectively.

Highlights of Achievements in FY13

1. Joint Cryo Backlighting

A new platform has been developed for backlighting 60-beam cryogenic target implosions on OMEGA using the OMEGA EP beam. A ten-inch manipulator (TIM)–based fast positioner has been developed that can place a backlighter target 10 mm from the cyrogenic target after the cryogenic shroud

Table 136.V: OMEGA Laser Facility Target Shot Summary for FY13.

Laboratory/ Program	Planned Number of Target Shots	Actual Number of Target Shots	ICF	Shots in Support of ICF	Non-ICF
CEA	40	53	0	0	53
LANL	170	206	21	0	185
LBS	155	163	0	0	163
LLE	390	428	0	416	12
LLNL	295	350	108	0	242
NLUF	150	183	0	0	183
UMich	10	10	0	0	10
Other	0	15	0	15	0
Total	1210	1408	129	431	848

Table 136.VI: OMEGA EP Laser Facility Target Shot Summary for FY13.

Laboratory/ Program	Planned Number of Target Shots	Actual Number of Target Shots	ICF	Shots in Support of ICF	Non-ICF
LANL	0	0	0	0	0
LBS	65	106	0	0	106
LLE	110	165	0	129	36
LLNL	110	158	58	0	100
NLUF	65	91	0	0	91
Other	0	56	0	56	0
Total	350	576	58	185	333

has been retracted. The target is inserted 80 mm in 70 ms with a position accuracy of 25 μm. This fast positioner is being utilized in concert with the spherical crystal imager to capture stop-action images of the cryogenic target during implosions.

2. 4ω Probe Diagnostics

Following the successful installation of the 4ω probe laser in the OMEGA EP Target Bay, the optical diagnostic infrastructure was commissioned in FY13. The first diagnostic leg that was activated can capture shadowgraphs or schlieren images of the laser–plasma interaction. A novel improvement to the schlieren diagnostic placed an angular filter at the Fourier plane to map the refraction of the beam at the target plane to contours in the image plane. The diagnostic also has additional ports available; a polarimetry diagnostic has been designed and will be completed in early FY14.

3. Neutron Temporal Diagnostic Replaced

The neutron temporal diagnostic (NTD) is the primary diagnostic for characterization of the reaction rate history of neutron emission for a DT or D_2 target experiment. The original NTD, in use for 15 years on OMEGA and ~10 years prior to that on NOVA at LLNL was decommissioned after the controls and mechanics became obsolete. The improved design increases the service access, shielding, and operability and modernizes the control electronics and streak camera.

4. Tritium Fill Station Cryo Permeator

The yield on cryogenic target shots has been improved by a factor of ~2 following the addition of a permeator. A Pd/Ag permeator removes organic impurities and decay helium from the DT fuel as the tritium is transported from the storage beds to the high-pressure fill system. This additional fuel purification step was added to the fill procedures and has been in use on all fills since 1 January 2013.

5. Sydor Framing Camera

In a joint development venture with Sydor Instruments LLC, a new gated x-ray detector has been fielded on OMEGA. The Sydor framing cameras can be paired with all unimount-compatible front ends including pinhole imagers and crystal spectrometers. It is compatible with film packs and also with a Sydor vacuum charge-coupled–device (CCD) camera design. Two units have been deployed, one "fast" and one "slow" camera.

6. Solid-State Pockels Cell Drivers

LLE has developed a custom solid-state Pockels cell driver to replace discontinued commercially available high-voltage power supplies. The large-aperture ring amplifiers in OMEGA utilize a pulsed Pockels cell in a configuration where thyratron high-voltage switching electronics were used reliably for the past 20+ years. These supplies were the only available technology that could achieve the required long-duration pulse and failsafe requirements to prevent laser damage. The replacement LLE device uses readily available metal–oxide–semiconductor field-effect transistor (MOSFET) solid-state electronics in an inductive–adder configuration to reliably produce pulses with improved rise times, fall times, and uniformity. Five of the LLE-designed power supplies were fabricated in FY13.

Experimental Operations and Diagnostics

Twenty-five new target diagnostics were commissioned in FY13 on OMEGA and seven on OMEGA EP. The OMEGA additions included the neutron temporal diagnostic (NTD) and framing camera projects described above. The two new Sydor x-ray framing cameras (SFC's) were commissioned on both OMEGA and OMEGA EP. Updates to the diagnostic inventory on OMEGA EP included the commissioning of the 4ω probe laser and diagnostic table, the slit imager for the ultrafast x-ray streak camera (UFXRSC), and the LLNL specular frequency-resolved optical gating (SpecFROG) diagnostic. Also on OMEGA, reflective spectrometer channels were added to the TIM-based μDMX x-ray diode array. As in previous years, many of the new instruments were developed by or in collaboration with other laboratories, including LLNL, LANL, and CEA.

Facility improvements on OMEGA included the Sydor CCD x-ray framing camera readout system, the FASTPOS target positioning system for cryogenic target backlighting, and the Port-2 neutron diagnostic inserter (NDI) system. Two additional OMEGA TIM's were retrofitted with new electromagnetic interference (EMI)–resistant control systems; four are now complete and the remaining two will be completed in FY14. Minor changes to the OMEGA target chamber and diagnostics improved the typical operating vacuum pressure by nearly an order of magnitude. On OMEGA EP, Target Viewing System (TVS) distortion correction was implemented.