FY06 Laser Facility Report

During FY06 the OMEGA Facility conducted 1394 target shots for a variety of users. Shaped-pulse cryogenic DT implosions highlighted the development of direct-drive cryogenic capability. A total of 12 D_2 and 15 DT direct-drive cryogenic target implosions were performed (see Table 108.VII). OMEGA Availability and Experimental Effectiveness averages for FY06 were 93.3% and 95.3%, respectively (see Fig. 108.56). Highlights of other achievements for FY06 include the following:

- The first of a series of direct-drive, ignition-scaled cryogenic targets containing tritium were imploded in February 2006. LLE achieved a DOE milestone in March by imploding two layered DT cryogenic targets containing tritium. The first high-yield, direct-drive, ignition-scaled, 50% DT cryogenic implosion was achieved in June 2006—the first time that such a target was imploded on an ICF facility. OMEGA is now fully capable of fielding high-tritium-fraction cryogenic

Table 108.VII: The OMEGA target shot summary for FY06.

Laboratory	Planned Number of Target Shots	Actual Number of Target Shots	IDI NIC	DDI NIC	Total NIC	Non-NIC
LLE	724	714	201	497	698	16
LLNL	325	348	243	0	243	105
LANL	121	125	54	0	54	71
NLUF	120	122	0	0	0	122
CEA	40	49	0	0	0	49
SNL	24	30	30	0	30	0
NWET	6	6	0	0	0	6
Total	1360	1394	528	497		369

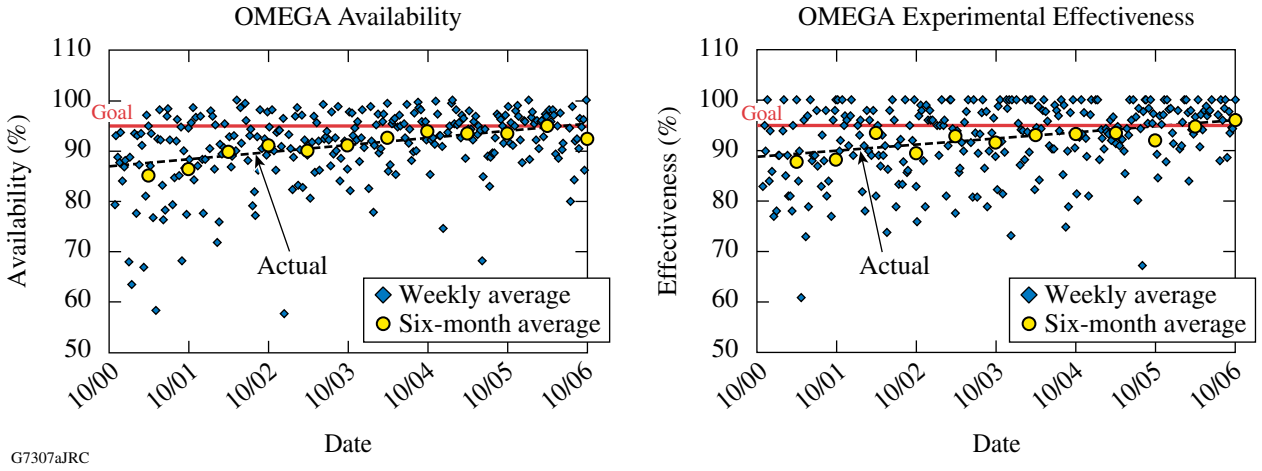

Figure 108.56
OMEGA Availability and Experimental Effectiveness data from FY01 to FY06.

targets and has the infrastructure in place to support the corresponding radiological issues.

- A full set of 42 new indirect-drive-ignition distributed phase plates (IDI DPP's) were designed and fabricated for National Ignition Campaign (NIC) experiments on OMEGA. The phase plates produce an elliptical far field (200 μm × 300 μm) at normal incidence and a nearly circular spot at the plane of the laser entrance hole (LEH) and can be oriented for use in both pent and hex configurations. Hohlraum energetics experiments using IDI DPP's were successfully conducted in August, completing a DOE milestone for the National Ignition Campaign. The primary objective of these experiments is to study the effect of laser-beam smoothing with phase plates on the radiation temperature and scattering losses of the hohlraum.

- Low-adiabat, high-contrast pulse shapes are required for OMEGA ignition-scaled cryogenic DT target experiments. Such pulse shapes are typically characterized by a narrow picket pulse on top of a low-intensity foot pulse, followed by a high-intensity drive pulse. The new front end on OMEGA—the integrated front-end source (IFES)—is a highly stable optical-pulse-generation system based on fiber amplification of an optical signal that is temporally carved from a continuous-wave fiber laser. The use of fiber-optic lasers and amplifiers and waveguide temporal modulators makes IFES ideally suited for producing reliable, stable pulse shapes. Recent experiments on OMEGA have required >100:1-contrast-ratio pulse shapes. The electrical waveform that drives the waveguide modulators to shape the pulse is produced using LLE's aperture-coupled-strip-line (ACSL) technology. The shape is designed to precompensate the temporal distortions in the laser due to amplifier gain saturation and nonlinear conversion in the frequency-conversion crystals (FCC's). Figure 108.57 shows (on a logarithmic scale) the design template and the measured ultraviolet laser pulse produced on target by OMEGA for pulse shape LA279901P. The match between the designed and measured shapes is excellent, particularly in the following critical pulse parameters: the picket energy, the >100:1-contrast foot, and the rising edge of the drive pulse.

- A year-long project to upgrade the active-shock-breakout (ASBO) diagnostic was completed in April 2006. The upgrade enables high-precision measurements and ease of operation for equation-of-state (EOS) and shock-timing experiments. Using the existing system as a baseline, the upgrade incorporates a new optical layout that uses the Rochester Optical Streak System (ROSS) streak cameras as detectors for the two velocity interferometer system for any reflector (VISAR) channels. The result is an outstanding optical device that provides excellent performance and smooth operation using the accurately calibrated ROSS cameras. Many experiments are using the new ASBO system. CCD camera data-acquisition capability for x-ray framing cameras was extended to TIM's 4 and 5 and is now available on all TIM's.

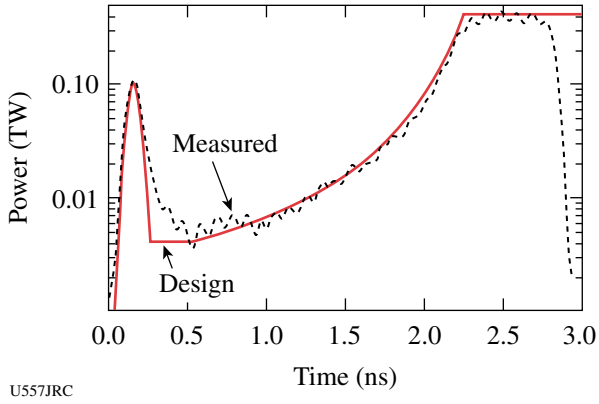

Figure 108.57
OMEGA single-beam pulse shape from low-adiabat cryogenic target implosions (shot #42966) using pulse shape LA279901P.

- The OMEGA EP short-pulse beam-transport tube was installed during an extended maintenance week in June 2006. The beam-transport tube connects the OMEGA EP grating compression chamber located within the OMEGA EP Target Bay to port P9 on the OMEGA target chamber. Significant structural modifications within the OMEGA target area were required to facilitate the installation of the short-pulse beam tube including target bay platform structural modifications, modifications required to facilitate access to OMEGA UV transport optics, and the addition of two Target Bay jib cranes. Facility modifications planned for FY07 include the relocation of TIM 2 from port H7 to port H3, installation of the off-axis parabola in port H7, and installation of the OMEGA EP transport mirrors on the east side of the OMEGA target chamber.