Section 4
LASER SYSTEM REPORT

4.A GDL Facility Report

During the fourth quarter of FY89, the highlight of the experimental program was the observation of soft x-ray lasing at 195 Å, 232 Å, and 236 Å. The lasing was produced by irradiating a germanium foil with a 15-mm-long line focus from the GDL laser. Neon-like germanium ions, which were collisionally excited by plasma electrons, provided the gain medium. Additional programs on GDL included the continuation of the shine-through experiments, the deployment of the short-pulse (~20-ps) probe beam in the Beta chamber, and a Thomson-scattering experiment. The shine-through experiments continued investigation of early-time phenomena in laser-produced plasmas, in particular the transmission of light through a target before the generation of a plasma. The probe beam that has been directed to the GDL target-irradiation facility will be used in two manners: first, as a backlight source (527 nm) for an imaging system that will investigate plasma generation and expansion; second, as a pump beam for Thomson-scattering experiments.

One NLUF user experiment, measurement of the ion-acoustic decay instability, by a group from the University of California at Davis (UCD) was conducted for an entire week.

A summary of the GDL operation follows:

Beamline Test, Calibration, Tuning, and Laser Alignment Shots	150
Target Shots	
Shine-through	52
X-Ray Laser	42
X-Ray Lithography	13
Probe Beam/Thomson Scattering	21
NLUF (UCD)	53
TOTAL	331

ACKNOWLEDGMENT

This work was supported by the U.S. Department of Energy Office of Inertial Fusion under agreement No. DE-FC03-85DP40200 and by the Laser Fusion Feasibility Project at the Laboratory for Laser Energetics, which has the following sponsors: Empire State Electric Energy Research Corporation, New York State Energy Research and Development Authority, Ontario Hydro, and the University of Rochester. Such support does not imply endorsement of the content by any of the above parties.

4.B OMEGA Facility Report

The final quarter in FY89 began with a thorough analysis of the state of power balance among the 24 OMEGA laser beams. A theoretical analysis was conducted using the MALAPROP laser-propagation code that determined the relationship between temporal pulse shape and system gain. A rather strong dependence of pulse shape on gain dictated that the gains of each of the 24 chains be equalized. In addition to adding amplifier small-signal-gain-measurement capability, the electrical-energy storage banks were converted to adjustable energy. Along with these significant power-balance improvements, there were newly developed smoothing by spectral dispersion (SSD) upgrades implemented and testing of them has begun on OMEGA.

A flip-in photodiode system, in conjunction with the OMEGA oscillator, is used to measure the optical gains of all amplifiers to within $\pm 2\%$ in a three-hour experiment. Results of these tests indicated some reduction in amplifier gain between maintenance operations. As amplifier modules were refurbished, the gain variation was reduced and large imbalances eliminated. Fine tuning to achieve exact gain equalization required control over the electrical pump source. This resulted in $\sim 2\%$-rms gain variations among the 24 beamlines.

A synopsis of laser shots for this quarter follows:

Software Test	68
Driver Line	86
Laser	280
Target	101
TOTAL	535

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