LASER FUSION ENERGY*

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We are developing the science and technologies for laser fusion energy. The main components are developed in concert with one another to develop Laser Fusion Energy as an integrated system. The lasers [krypton-fluoride (KrF) and diode-pumped solid-state laser], the chamber, final optics, target fabrication and target injection are developed under the HAPL program. Target designs and experiments are carried out largely through the DOE ICF program.

Recent advances include: Target designs, backed with 2D simulations, show sufficient gain (>150) for fusion energy. The KrF laser produces 650 J/pulse at 1 Hz and 5 Hz, and the individual components meet the efficiency and beam smoothing requirements. The durability of the electron beam window is the major outstanding issue. The DPSSL produces 35 J/pulse in 5 Hz runs of over 10^5 shots, with efficiency and beam smoothing the main outstanding issues. A chamber "operating window" has been established that avoids first wall vaporization and allows target injection. A model has been developed to study how the chamber evolves between shots. The remaining issue of long term material behavior is being addressed with experiments that expose first wall materials to relevant ions and x-rays. Final optics studies have shown that a grazing incidence aluminum mirror meets the reflectivity requirements and exceeds the required laser damage threshold. For the targets: IFE sized foam shells have been mass produced, the required target specifications for DT ice smoothness has been met (but not on a mass production basis); and the cost of target production and injection has been modeled to be about $0.16 each. A facility to accelerate, inject and track targets has demonstrated the concept of a separable sabot and met the required injection velocity. The pointing accuracy is within a factor of five of the IFE requirement.

We propose to develop laser fusion energy in three phases. The present Phase I program is developing the critical science and technologies. Phase II would develop and integrate full size components. Phase III, the Engineering Test Facility (ETF), would: 1) optimize laser-target and target-chamber interactions, 2) develop materials and components; and 3) generate net electricity from fusion. We could be prepared to start construction of the ETF within ten to twelve years.

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This is a summary of work performed by researchers from over 20 institutions. For a detailed list of collaborators, see: J.D. Sethian, et al, "Fusion Energy Research with Lasers, Direct Drive Targets, And Dry Wall Chambers," Nucl. Fusion, **43, 1693-1709 (2003).