ADDRESSING THE ISSUES OF TARGET FABRICATION AND INJECTION FOR INERTIAL FUSION ENERGY*

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Addressing the issues associated with target fabrication and injection is a major part of an international program to establish the feasibility of Inertial Fusion Energy (IFE), both for laser-driven and heavy-ion driven concepts. A description of the unique materials science and chemistry research associated with supplying targets for an IFE power system are presented, as well as analyses of the target response during injection, and cost modeling of the target supply process.

The "Target Fabrication Facility" of an IFE power plant must supply about 500,000 targets per day. Target fabrication has concentrated on investigating and developing the various materials needed by the target designs and on fabrication techniques that could eventually scale to low cost and high production rate. After manufacture, the target is injected into the target chamber at a rate of 5–10 Hz. The DT layer must survive the exposure to the extremely high heat flux and remain highly symmetric, have a smooth inner ice surface finish, and reach the chamber center at a temperature of about 18.5 K. Models of the thermo-mechanical effects on the advanced materials during injection have been developed. Fundamental measurements of the properties and response of DT under these unique conditions are being carried out. An experimental injection and tracking system is being constructed to develop technologies and to demonstrate meeting these challenging requirements.

We must also understand the issues that affect low-cost target production – studies have consistently shown that a cost reduction of at least four orders of magnitude from current technologies will be needed for future electricity production. This issue is often considered to be one of the major feasibility issues for future commercial application of inertial fusion. We have now, for the first time, prepared an engineering analysis of all of the process steps needed to mass-produce direct drive targets having gains suitable for commercial fusion in a laser driven system. We have performed this cost analysis based on a commercial process plant environment. This modeling of target fabrication includes process flows, mass-energy balances, plant utilities, raw materials, quality control, waste handling and recycle, capital equipment cost amortization, and staffing requirements. Inputs to the model show that the future cost goals of less than about $0.25 per target can be met. This highly encouraging result is a major breakthrough in addressing a major technical feasibility issue of IFE.

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