

## ABSTRACT

Fueling of a commercial Inertial Fusion Energy (IFE) power plant consists of supplying about 500,000 fusion targets each day. The most challenging type of target in this regard is for laser-driven, direct drive IFE. Spherical capsules with cryogenic DT fuel must be injected into the center of a reaction chamber operating at temperatures as high as 1500°C and possibly containing as much as 0.5 torr of xenon fill gas. The DT layer must remain highly symmetric, have a smooth inner ice surface finish, and reach the chamber center (CC) at a temperature of about 18.5 K. This target must be positioned at the center of the chamber with a placement accuracy of  $\pm 5$  mm. The accuracy of alignment of the laser driver beams and the target in its final position must be within  $\pm 20$   $\mu\text{m}$ . All this must be repeated six times per second. The method proposed to meet these requirements is injecting the targets into the reaction chamber at high speed ( $\sim 400$  m/s), tracking them, and hitting them on the fly with steerable driver beams. The challenging scientific and technological issues associated with this task are being addressed through a combination of analyses, modeling, materials property measurements, and demonstration tests with representative injection equipment. Measurements of relevant DT properties are planned at Los Alamos National Laboratory. An experimental target injection and tracking system is now being designed to support the development of survivable targets and demonstrate successful injection scenarios. Analyses of target heating are underway. Calculations have shown that the direct drive target must have a highly reflective outer surface to prevent excess heating by thermal radiation. In addition, heating by hot chamber fill gas during injection far outweighs the thermal radiation. It is concluded that the dry-wall, gas-filled reaction chambers must have gas pressures and wall temperatures less than previously assumed in order to prevent excessive heating in the current direct drive target designs. An integrated power plant systems study to address this issue has been initiated.