# ARIES-IFE Assessment of Operational Windows for IFE Power Plants

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The ARIES-IFE study, a national US effort involving universities, national laboratories and industry was an integrated study of IFE chambers and chamber interfaces with the driver and target systems. Rather than focusing on a single design point, the study aimed at identifying design windows, trade-offs, and key physics and technology uncertainties for various IFE chamber concepts.

An essential of element of such a study is the detailed characterization of the target yield and spectrum. We have selected heavy-ion indirect target designs of LLNL/LBL and direct-drive target designs of NRL as our reference targets. Detailed spectra from these two targets have been calculated -- their photon and ions/debris spectra are vastly different. Our analysis indicates that this detailed information of the target yield and spectrum plays a crucial role in defining the design windows for IFE systems.

Three main classes of chamber concepts are analyzed including dry walls, wetted-walls (thin-liquid-protected) and thick-liquid wall concepts. The three classes of chamber concepts use different schemes to ensure survival of the first wall: gas protection for dry walls or liquid protection for the other two. In each case, survival of the first wall leads to sever constraints on the chamber size and geometry, material choices, and maintenance of chamber protection scheme (*e.g.*, replenishment of liquid protective layer). As a result of interaction of target particle and energy flux with the first wall, material is evaporated or ejected into the chamber. These materials evolve, cool, and are pumped out during the transition between driver shots. The chamber environment prior to the next shot will depend on the evolution of the chamber constituents during the time between shots. A cryogenic target has to be injected and tracked in this chamber and the driver beams should propagate and be focused in this pre-shot chamber environment. Constraints imposed by target survival during the injection process and driver beam transport and focusing can be translated back into requirement on the chamber itself, further restriction the design space available for the chamber.

By overlaying the constraints from various systems such as target injection and tracking, thermal response of the first wall, and laser or heavy-ion propagation and focusing, one can arrive at operational windows for IFE power plants. These constraint and the resultant operational windows are discussed in this paper. This process has allowed us to identify key uncertainties and directions for further R&D.