Assessment of Chamber Concepts for Inertial Fusion Energy Power Plants – The ARIES-IFE study

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The ARIES-IFE study, a national US effort involving universities, US national laboratories and industry is 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 aims 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 design of NRL as our reference targets. Detailed spectrums from these two targets have been calculated – their photon and ions/debris spectrum are vastly different. Three main classes of chamber concepts are analyzed including dry walls, solid structures with protective zones (*e.g.*, wetted walls), and thick liquid concepts. The design window for each combination of target and chamber is being explored. For example for dry wall chambers with direct-drive targets, analysis of target heating during injection in the chamber leads to upper limits on chamber gas and chamber wall temperature. Incident energy and particle fluxes on the wall of the chamber have been calculated and thermal response of the wall is analyzed. Survival of the wall requires that the gas pressure in the chamber to be above certain level in order to lengthen the energy pulse arriving at the wall. It appeared previously that no design solution is possible given these two constraints. Our detailed analysis showed, however, that a design window for dry-wall chambers exists in which the gas pressure was low enough to allow for successful injection while ensuring wall survival. Similar analysis has been performed for indirect driver target.

The drive/chamber interface (final optics and beam propagation in the chamber) issues also under study. These include analysis of: laser propagation in gas-filled chamber, grazing incident metal mirrors (GIMM) as final optics, propagation and focusing of heavy-ion beams in relatively high-pressure chambers and design and optimization of final focus magnets.Parametric systems analysis as well safety analysis is performed to identify relative advantages of each concept.

The ARIES-IFE study was initiated in June 2000 and is to be completed in summer of 2003. In this paper, we well present our analysis of dry wall and wetted wall concepts.

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