Integral Study of IFE Power Plant based on Direct Drive and Non-Protected Chamber (HiPER)

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Among the different proposals for Inertial Fusion Energy (IFE) Reactors, the European initiative developed in the past years (HiPER) represents that of Direct Drive (by Shock, Fast Ignition) with No protected chamber. Key subject to get final goals is development of advance materials for first wall, structural, optics and shielding components. The first wall (FW) solution is based on advanced materials such as nanomaterials, to withstand for long lifetime. We describe the potential synergetic effect of neutron irradiation in ion damage mechanism of FW. The effect of neutron, ions and X-rays in optics is described with conclusions on their relative importance. In order to maintain the lens temperature constant at any time (start-up, normal operation, different output regime…) we have designed an engineering system based on a cooling fluid. The system has been designed to optimize the most important operation parameters, i.e., uniformity and efficiency, to avoid aberrations and fulfil the final optics demands.

In the Blanket design we work a Dual Coolant Systems with a modular structure in a spherical chamber. He and PbLi are proposed as coolant of First Wall and main system for heat extraction and tritium breeding, respectively. Different proposals have been made to know the role in our systems of Li enrichment, and some conclusions are given; in addition effects of corrosion are considered as an important parameter for final evaluation. The Power Plant cycle has been defined and will be presented.

Concerning the target material, we simulate EOS and phase transitions of Deuterium-Tritium; the mechanical properties under manufacturing conditions with cryogenic temperatures and pressures below 1 Gpa, and shock propagation in Be nano, nanodiamond and foams.


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