NEUTRONICS OF HEAVY ION FUSION CHAMBERS*

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The leading candidate for a Heavy Ion Fusion (HIF) chamber is the thick-liquid wall concept, where a liquid (usually a lithium molten-salt) is used to attenuate neutrons and protect the solid structures from radiation damage, therefore lengthening the lifetime of components. This thick-liquid wall is also used to remove the heat from the fusion chamber and to breed the tritium fuel that is consumed during the fusion process. A very important advantage of the thick-liquid concept resides in the fact that the neutron spectrum at the chamber first wall (FW) has lower energy and intensity than that experienced in a dry wall system. Therefore, an HIF chamber could be built with materials that have already been developed and tested for neutron damage using currently available fission irradiation sources.

In this paper we investigate the nuclear characteristics of an HIF thick-liquid wall chamber in terms of neutron attenuation capability for FW protection. Starting with the HIF target output spectra, we have used a Monte Carlo neutron transport code to calculate the chamber spectra for various candidate liquids and thicknesses. We have used available radiation damage data from fission reactor testing to evaluate the performance of various steels as potential FW material. It is found that while some transmutant generation and temperature history effects may require further investigation, the development path for HIF chambers may not require the construction of a 14 MeV neutron source for chamber material testing.

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