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MHD (MAGNETO-HYDRODYNAMICS) IN LIQUID METALS IN FUSION REACTORS: EFFECTS ON TRITIUM TRANSPORT AND INVENTORY

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ABSTRACT

The Water Cooled Lithium Lead (WCLL) is one of the breeding blanket concepts proposed for DEMO reactor. The velocity field of the electrically conducting lead-lithium eutectic alloy inside the blanket is highly influenced by the external magnetic field used for plasma confinement, due to a magnetohydrodynamic (MHD) effect. In addition, strong temperature gradients give rise to buoyancy forces, that have a great impact on flow behavior. MHD and convection significantly influences the resulting temperature and velocity fields, and therefore tritium transport. A multi-physics approach of a 3D tritium transport model is presented for a simplified geometry of the WCLL breeding blanket. In particular, MHD, buoyancy forces, advection-diffusion of tritium into the lead-lithium eutectic alloy, transfer of tritium from the liquid interface towards the steel and diffusion of tritium inside the steel have been included in this study. Tritium permeation from PbLi to the baffle, tritium concentrations and inventories inside the lead-lithium and in the EUROFER baffle have been evaluated.

Keywords: DEMO, Liquid metal blanket, WCLL, MHD, Magneto-convection, buoyancy forces, Tritium transport