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DEMO Port Plug Design and Integration Studies

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The Power Plant Physics and Technology department (PPPT), being part of the EUROfusion Consortium established in 2014 and composed by European Fusion Laboratories (EFL), aims to develop a conceptual design for the Fusion DEMOnstration Power Plant.

With respect to present experimental machines and ITER, the main goals of DEMO are to produce electricity continuously for a period of 2 to 4 hours, with a net electrical power output of the order of a few hundreds of MW, and to allow Tritium self-sufficient breeding with an adequately high margin in order to guarantee its planned operational schedule, including all planned maintenance intervals. This will eliminate the need to import tritium fuel from external sources, except for plant start-up. In order to achieve these goals, extensive engineering efforts as well as physics studies are required to develop a design that can ensure a high level of plant reliability and availability. In particular, interfaces between systems must be addressed at a very early phase of the project, in order to proceed consistently.

In this paper we present a preliminary design and integration study, based on physics assessments for the EU DEMO1 Baseline 2015 with an Aspect Ratio = 3.1 and 18 Toroidal Field Coils, for the DEMO port plugs. These aim to host systems like Electron Cyclotron Heating (ECH) launchers currently developed within the PPPT Work Package Heating and Current Drive (WPHCD) that need an external radial access to the plasma that collides with in-vessel systems like the breeder blanket. A similar approach could be in principle followed by other systems, e.g. other heating and current drive systems or diagnostics.

The work addresses the interfaces between the port plug and the blanket on the specific example of the Helium-Cooled Pebble Bed (HCPB) which is one of four breeding blanket concepts under investigation in Europe within the PPPT Programme: the required openings will be evaluated in terms of their impact onto the blanket segments thermo-mechanical and nuclear design considering mechanical integration aspects but also their impact on Tritium Breeding Ratio (TBR). Since we are in a conceptual phase, the same methodology is applicable to the other three blanket concepts, as well.

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