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Overview of DEMO Divertor Architecture Design options

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The divertor is one of the key components of the EU-DEMO reactor. The development of a reliable solution for the power and impurity particle exhaust is recognized as a major challenge toward the realization of DEMO. The pre-conceptual design activities for the EU-DEMO divertor are carried on considering two project areas: the 'Target development', focusing on the design of the vertical targets directly facing the plasma, and the 'Cassette design and integration', dealing with the design of the cassette structure and the integration of sub-components. The essential aim of the project is to develop in both project areas advanced design concepts for a divertor system capable of meeting the physical and system requirements defined for the EU-DEMO reactor.
In this work, a general overview of the EU-DEMO divertor cassette design is presented, considering systems requirements, structural assessments and interfacing systems. The design solutions adopted for the integration of the main divertor sub-components are described, in terms of layout and attachment to the cassette body (CB) of the Plasma Facing Components (PFCs), liner, reflector plates and cassette-to-vacuum vessel fixation system (nose at the inboard and wishbone at the outboard).
Different materials are integrated on the divertor cassette, requiring different cooling temperatures and leading to different behaviors to consider. In particular, Eurofer97 ferritic-martensitic steel has been selected for the cassette structure in order to meet the activation and radwaste requirements. As a consequence of this choice, in 2021 two different cooling circuits have been analyzed for the divertor cassette, one working at 180℃ and 3.5 MPa as operating conditions for the Cassette Body, the other providing coolant water for the PFCs (CuCrZr pipes) at 130℃ and 5 MPa.
In 2022 many critical remote handling issues have been studied such as the assembly and disassembly of the PFC, the radwaste material weight reduction, simplification of the piping layout and relative manufacturing, the optimization of the cooling condition between divertor and blanket using water under the same physical condition etc. These studies converged on an alternative solution using for the cassette and other Eurofer components (as reflector plates, shielding liner etc.) a cooling circuit with high pressure and temperature (p=15 MPa; T= 300 ℃) similar to the breeding blanket cooling conditions.

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