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European DEMO divertor R&D activities: loads, design concepts and technologies

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As the first funding period of EUROfusion Consortium is nearing its end, the work package “DEMO divertor” (WPDIV) is entering the final project period concluding its preconceptual design activities. The primary mission of WPDIV is to deliver holistic design solutions of the divertor targets as well as the cassette and to assure the availability of required technologies at least with a preconceptual maturity. Numerous tasks have been performed in WPDIV covering the full spectrum of design study and technology development including design rationales, CAD models, multiphysics analysis and load specifications, cooling scheme, design optimization, joining technology, mock-up fabrication, inspection, high-heat-flux (HHF) fatigue tests, post-examination, failure modelling, and guidelines for structural design and analysis. After 5 years of the preconceptual phase, a remarkable progress has been achieved with successful outcomes. In this contribution, an overview and the latest results of WPDIV works are presented. One of the highlights will be the recent HHF qualification testing campaign where several different design concepts of plasma-facing components were evaluated in terms of fabrication quality, HHF fatigue performance and structural reliability using small scale mock-ups. All design concepts shall be subject to down-selection process to be made eligible for the subsequent industrial upscaling stage. Further highlights are specification of loads and optimization of the cooling circuits for the entire divertor cassette system. To this end, an integrated multiphysics approach was employed covering neutronic, thermal, hydraulic, electromagnetic and structural stress analysis. In addition, a brief overview is given on the supporting tasks such as corrosion (coating, testing), inelastic design guidelines, CAD of cassette fixation system and non-destructive inspection techniques. Finally, the future R&D strategy is briefly outlined, including an indicative description of the planning and preparation for the following conceptual design phase.

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