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Comparative Overview of Divertor Cassette Design and Integration in EU-DEMO, VNS and DTT

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The design of the divertor is one of the most critical challenges in the development of fusion reactors due to various intensive driver loads and dependence on physics modelling. It must exhaust a significant fraction of the plasma heating (mainly from fusion alphas) which is conducted through the Scrape-Off Layer (SOL) during normal, transient, and off-normal events, while also protecting the vacuum vessel from nuclear loads and providing a plasma-facing surface compatible with intense plasma–material interactions. Managing power exhaust in the divertor region is therefore a central challenge for reactor-scale fusion devices, requiring advanced engineering solutions, intensive technological developments and testing, and the careful integration of subcomponents under stringent thermal, structural, and operational constraints.
This contribution presents a comparative overview of the divertor design approaches adopted for three major European tokamak devices currently under development within the framework of Eurofusion activities: EU-DEMO, the Volumetric Neutron Source (VNS), and the Divertor Tokamak Test facility (DTT). While the EU-DEMO divertor is primarily driven by large-scale reactor dimensions and stringent plant availability requirements, the divertors of VNS and DTT share similar geometric scales but diverge significantly in terms of magnetic configuration flexibility and neutron load conditions. Starting from the main design drivers and boundary conditions for each machine, we examine both commonalities and specific challenges across the three concepts, with a focus on geometric integration, heat flux management, coolant operating conditions, structural and electromagnetic (EM) loads, and compatibility with remote handling (RH) systems. This comparative analysis aims to highlight synergies across the three concepts, and to explain how design choices are shaped by machine mission, performance targets and operational context.

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