Contribution ID: **11** Type: **Poster**

Assessment of the pumping efficiency in DEMO conventional and alternative divertor configurations

Wednesday 6 November 2019 17:45 (15 minutes)

The design of a DEMO divertor is an important task which defines the reflux of fuel and helium neutral particles to the plasma and finally determines the particle exhaust and pumping efficiency. For the conventional divertor, optimization of the dome height and its effect on neutral compression, position of the pumping ports as well as the effect of neutral gas screening by electrons in the private flux region (PFR) are analyzed. The analysis includes the calculation of neutral density in the sub-divertor and the overall conductance of the sub-divertor structure, which consequently affects the estimation of the effective pumping speed and the achievement of detachment. The divertor configuration with dome impedes the reflux of neutrals towards the plasma through the x-point. The screening of the neutrals from backflow to the Scrape-off layer (SOL) by plasma electrons at the separatrix is estimated.
Alternative configurations for the DEMO divertor are being explored to achieve an improved mitigation of the heat and particle loading at the plasma-material interfaces. These configurations with a variable volume in the PFR, which consequently influences the neutral behavior and hence the achieved divertor pumping efficiency. This paper studies, in terms of the pumping efficiency, a wide range of prominent proposed alternatives to the conventional, single-null divertor, namely the "double null"divertor, the "X divertor", the "Super-X divertor" and the "snowflake"divertor.
The investigation of the impact of neutral gas dynamics on the particle exhaust for different divertor configurations under steady-state operation is performed using the numerical tools DIVGAS (Divertor Gas Simulator) and ITERVAC. The DIVGAS code is based on the Direct Simulation Monte Carlo (DSMC) method, in which the solution of the Boltzmann kinetic equation is reproduced by simulating the collisions and the ballistic flight of model particles, which statistically mimic the behavior of real molecules. The ITERVAC code is a semi-empirical code which models divertor configurations as a network of connected channels and is appropriate for quick engineering calculations. In our workflow, the neutral flow field for each of the divertor configurations is derived from plasma boundary conditions along the separatrix, extracted from corresponding plasma simulations, exactly at the interfaces between the SOL and the PFR. All assumed plasma scenarios are based on a highly dissipative divertor relying on a partially detached divertor operating regime, similar to ITER, or even on full detachment. Moreover, the position and the size of the pumping port as well as the influence on the neutral flow behavior in the PFR are analyzed and the advantages and disadvantages of each case are discussed.
This work is complementary to the overview papers on the conventional divertor and on the alternative configurations.

Country or International Organization

Germany

Authors: IGITKHANOV, YURI (Karlsruhe Institute of Technology); VAROUTIS, Stylianos (Karlsruhe Institute of Technology (KIT)); DAY, Christian (Karlsruhe Institute of Technology); Mr HAUER, Volker (Karlsruhe Institute of Technology (KIT))

Presenter: IGITKHANOV, YURI (Karlsruhe Institute of Technology)

Session Classification: Poster Session III

Track Classification: Divertors for DEMO and Reactors