Contribution ID: **19** Type: **Oral (Plenary Session)**

Overview of the physics and diagnostics modelling activities for the EU-DEMO divertor

Wednesday 6 November 2019 12:30 (30 minutes)

The current baseline EU-DEMO, as designed by the EUROfusion Power Plant Physics & Technology Department (PPPT), considers an ITER-like LSN divertor for particle and power exhaust. Various modelling activities have been undertaken in the past years to assess the performance of this key machine component, both concerning plasma physics and engineering design. Goal of the present work is to provide an overview of the status of the ongoing investigations related to plasma physics and diagnostics (concerning the steady-state phase and the off-normal transients, but disregarding the role of ELMs). The EU-DEMO divertor is designed to withstand a steady-state heat flux of 10 MW/m2 and higher loads during transient events, while implementing a considerable safety margin to account for uncertainties. At the same time, the temperature of the impacting plasma shall be below 5 eV to avoid excessive sputtering of the W armour. These requirements can only be met when the divertor plasma is in a detached state. For detachment, it is necessary to dissipate a large fraction of the power crossing the separatrix using seeded radiative impurities. Both fluid and kinetic SOLPS simulations have been performed to determine the conditions under which a robust detachment can be obtained and maintained, with particular attention to the evaluation of the necessary seeded impurity fluxes. Also, SOLPS results have been employed as boundary conditions for the codes DIVGAS and ITERVAC, to assess the He removal from the plasma chamber by the pumping systems. Such removal shall in fact occur at a rate equal to He generation from the fusion reactions, in order not to let the concentration in the core increase up to a level where the reactor performance deteriorates. A further aspect of particular importance in the EU-DEMO design is the protection of the divertor for a time sufficient to ramp-down the plasma current in case detachment is lost. This is necessary as the fragility of the breeding blanket wall does not allow for a loss of plasma control at full current following a fast shutdown. Currently, strike point sweeping by means of in-vessel magnetic coils is the favoured option. This strategy assumes the existence of divertor detachment diagnostics that allow the detection of reattachment with sufficient time resolution. Spectroscopy and thermocurrent measurements, foreseen to perform this task, are presented and discussed. Finally, investigations performed by coupling the transport code ASTRA to a 0-D SOL and divertor model, with the purpose of evaluating the impact on the core plasma of the SOL seeded impurities, are illustrated. Results concern both steady-state simulations as well as dynamic cases, modelled with the ASTRA/Simulink DEMO control simulator.

Country or International Organization

Germany

Authors: SICCINIO, Mattia (EUROfusion Consortium); Dr BIEL , Wolfgang (Forschungszentrum, Jülich,); Dr CAVEDON , Marco (Max-Planck-Institut für Plasmaphysik,); Dr ELSHAWISH , Samir (Jožef Stefan Institute, Ljubljana, Slovenia); FABLE, E. (Max Planck Institut für Plasmaphysik, Garching bei München, Germany); Dr FEDERICI, Gianfranco (EUROfusion Consortium); Dr GIANNONE, Louis (Max-Planck-Institut für Plasmaphysik, Garching bei München, Germany); Dr HÄRTL , Thomas (EUROfusion, PPPT Department, Garching, Germany); Dr HAUER , Volker (Karlsruhe Institut für Technologie (KIT), Karlsruhe, Germany); JANKY, Filip; Dr KAPPATOU , Athina (Max-Planck-Institut für Plasmaphysik, Garching bei München, Germany); MAVIGLIA, Francesco (EUROfusion, PPPT Department, Building R3 Boltzmannstr. 2 Garching 85748, Germany); Dr SUBBA , Fabio (NEMO Group, Politecnico di Torino, Turin, Italy); Dr VAROUTIS , Stylianos (Karlsruhe Institut für Technologie (KIT), Karlsruhe, Germany); Dr VORPAHL , Christian (EUROfusion, PPPT Department.); WU , Haosheng (NEMO Group, Politecnico di Torino, Turin, Italy)

Presenter: SICCINIO, Mattia (EUROfusion Consortium)

Session Classification: DEMO Divertor Designs

Track Classification: Divertors for DEMO and Reactors