Progress on the design of a DEMO high power ICRH travelling wave antenna mock-up to be tested on WEST

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The travelling wave array (TWA) antenna has been proposed for the ICRF heating of the reactor in view to decrease the antenna power density [1]. The reduction of the antenna voltage and associated electric field and current is compensated by the increase in the number of radiating straps minimizing at the same time the number of feeding lines.

WEST represents the ideal device to test a reactor relevant TWA due to its long pulse capability and full metal wall configuration. The already installed ICRH high power launchers allow a direct comparison between a classical in-port antenna [2] and the TWA.

This contribution presents the progress in the design of an actively cooled high power mock-up of the WEST TWA antenna that will be tested in the TITAN [3] facility. The main objective is to assess the voltage stand-off of the antenna at a power level relevant for future operation. In order to be installed and operated in WEST, the antenna design proposed in [4] has to comply with the specific machine requirements, in particular active cooling, magnetic configuration and interface with existing auxiliary heating systems.

In first step the radial and poloidal location of the antenna is selected based on physics and operational constraints. The toroidal magnetic field ripple and its influence on the array RF property are investigated. Based on simulated and reconstructed equilibria, the trajectories of field lines connecting the antenna with other plasma facing components are traced. The particle heat loads could then be evaluated by means of ad-hoc codes like PFCflux [5]. The thermal load on the antenna is estimated considering plasma radiation, RF losses and energetic particles loads. The RF losses on the antenna are computed for the foreseen input power level, based on the choice of the feeding circuit and the constraint on the maximum allowed power for the existing vacuum feedthrough. An initial assessment of mechanical compatibility in case of vertical displacement events (VDE) is performed.

In conclusions, the next steps and implications of the project are outlined.

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