

A Travelling Wave Array System as Solution for the ICRF Heating of DEMO

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Travelling Wave Array (TWA) antennas distributed all along the periphery of the tokamak are presently considered as Ion Cyclotron Resonance Frequencies (ICRF) heating solution for the DEMO reactor. Compared to the conventional ICRF antenna systems currently in use or designed for future machines like ITER, the TWA consists of antenna sections integrated in the breeding blanket all around the machine, each one fed through a variable coupler in a resonant ring configuration.

Modelling an antenna system for DEMO with 18 quadruple TWA sections of 8 straps shows that a power capability exceeding 60MW can be obtained in the frequency band of interest using the reference low coupling plasma profile of ITER. The described system optimizes the coupling to the plasma providing a large number of radiating elements, which results in enhanced antenna directivity, and decreasing the antenna power density. This results in a maximum strap voltage amplitude of only 15kV and maximum inter-strap voltage amplitude of 18kV. The on purpose absence of vertical septa between straps increases the performance of the TWA compared to the classical antenna layouts. The generators remain matched for all loading conditions: the system is totally load resilient. A TWA fed with a resonant ring circuit should allow having almost 100% of the generator power injected in the plasma with associated negligible damping in the dummy load of the variable coupler. The Voltage Standing Wave Ratio (VSWR) remains close to 1 for a broad range of loading resistances and frequencies.

The proposed TWA system has been successfully tested on a scaled mock-up loaded by a salty water dummy load. The system tuning procedure is simple and an algorithm is under development. To assess the feasibility of the TWA fed by a resonant ring for a DEMO reactor a test on an existing Tokamak is under study.

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