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Future R&D toward Microwave H&CD systems for Commercialised Fusion Reactors

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The requirements of a microwave heating and current drive (mm-wave HCD) system applied to a commercial fusion reactor differ significantly from the present-day systems used for magnetic confinement research devices. The latter require versatile systems that can provide a variety of HCD applications to adapt to changing physics objectives when investigating the optimum plasma scenarios for a future burning reactor. High power sources with steerable launchers at the plasma boundary are a key aspect in exploring the usage of mm-wave HCD. However, extrapolating to a burning fusion reactor, the design criteria need to be re-orientated towards optimising plug-to-plasma efficiency, steady-state operation, longevity, RAMI, cost, etc. The development of the Spherical Tokamak for Energy Production (STEP) HCD system is beginning to bridge this gap toward commercialisation and as a result improvements are being identified for all parts of a future commercialised mm-wave HCD system.
The aim of this presentation is to review the requirements of a fusion power plant ⊠-wave HCD system and then outline R&D tasks required toward satisfying those requirements. The list of tasks includes improvements to the high voltage power supplies, mm-wave sources, transmission system and launchers. The discussion focuses in particular on the STEP requirements – a reactor grade spherical tokamak, aiming to achieve a net power gain back to the grid. STEP has a moderate field (˜3.2T) and a steady state HCD power demand ˜150MW.

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