RF MODELING OF THE ITER LOWER HYBRID ANTENNA

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In the frame of the EFDA task HCD-08-03-01, a 5 GHz Lower Hybrid system being able to deliver 20 MW CW on ITER and sustains the expected high heat flux has been reviewed [1]. The design of the key RF elements of the antenna such as the Passive-Active Multijunction (PAM), TE_{10}-TE_{30} mode converter, 3 dB splitter and RF window has been updated. Overall dimensions have been updated from the 2005 design [2] in collaboration with ITER organization. ITER mechanical constraints, such as the port plug size or the rear flange have been taken into account since the initial RF design. The main parallel index has been chosen to be $n_{//}$=2.0 with a flexibility of [1.8-2.2] in order to maximize the current drive efficiency. In parallel to the RF design, the coupling to the plasma has been studied with the ALOHA and TOPLHA codes and results are in good agreement.

The antenna is made of 48 identical modules, 12 on the toroidal direction and 4 on the poloidal direction. Each module is terminated by a RF window located inside the frame and connected to a poloidal 3 dB splitter which feeds 2 TE_{10}-TE_{30} mode converters. Each of these mode converters divides the power into 3 poloidal rows corresponding to the input of a 4 active waveguides multijunction. An optimization of the multijunction and the mode converter has been made in order to reduce VSWR and total length in order to satisfy the ITER frame constraints.

5 GHz CW RF windows capable of sustaining 500 kW are one of the most challenging RF devices of this antenna, since the ceramic which separates the tokamak vacuum from the pressurized transmission line must handle and evacuate high RF power density flux. Different designs have been proposed based on pill-box geometry and actively water cooled. Efficient designs ensuring low theoretical return loss and acceptable dielectric RF losses for beryllium oxide (BeO) window has been found.

All the devices which have been separately studied have been integrated together, allowing a RF characterization of the whole antenna and further optimization for neutron shielding.

[1] G.T. Hoang et al., A Lower Hybrid Current Drive System for ITER, Nuclear Fusion, 2009
[2] Ph. Bibet et al., Toward a LHCD system for ITER, Fusion Engineering and Design 2005