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ITR/P1-08: RF Optimization of the Port Plug Layout and Performance Assessment of the ITER ICRF Antenna

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ITER ICRF antenna's capability to couple power to plasma is determined by the plasma Scrape-Off Layer (SOL) profiles, shaping of the front strap array, organized as a 6 poloidal by 4 toroidal array of short straps, overall layout of the feed network and detailed design of its RF components. The first two factors are taken into account in the TOPICA [1] calculated strap array 24x24 S/Z-matrices. This data is coupled to a RF circuit model of the strap feeding circuit of which the components are S/Z matrices calculated with CST Microwave Studio (MWS) [2], such as the 4 Port Junction (4PJ) which combines 3 poloidaly adjacent straps so as to obtain a 2 poloidal by 4 toroidal array of triplets, or simple Transmission Line (TL) sections for the rest of the Removable Vacuum Transmission Line (RVTL) which include the Service Stub tee (SST) and Vacuum Ceramic Windows (VCW).
The RF feeding circuit inside the port plug is optimized in order to maximize the power coupled to the plasma for the various phasings considered for operation. This takes into account geometrical constraints, assembly requirements and RF quantities (E-field less than 2kV/mm along the magnetic field in the torus vacuum areas and less than 3 kV/mm perpendicular to the magnetic field and private vacuum areas, voltages less than 45 kV and currents through RF contacts less than 2 kA).
The ITER-Like Antenna on JET results obtained in 2008-9 [3] support the proposed design by having validated the TOPICA coupling estimations as well as demonstrated that there were no unforeseen difficulties in operating at 42 kV and power densities in the range required by ITER in terms of reliability and possible ICRF impurity production.
The effect of the RF grounding of the Front Housing Module, carrying 2 toroidaly adjacent triplets, as well as the grounding of the whole antenna port plug to the vessel is analyzed as well in conjunction with the Blanket Shielding Modules surrounding the antenna.

[1] "TOPICA: an Accurate and Efficient Numerical Tool for Analysis and Design of ICRF Antennas", V. Lancellott et al., Nuclear Fusion, Vol. 46, pp. S476-S499, 2006.
[2] CST GmbH, CST Microwave Studio®, User Manual (2011)
[3] "Latest Achievements of the JET ICRF Systems in View of ITER", F. Durodié et al., 23rd IAEA FEC, Daejeon, Republic of Korea, 2010.

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