PERFORMANCE OF THE SCATTERING MATRIX ARC DETECTION (SMAD) SYSTEM ON THE JET ITER-LIKE ICRF ANTENNA

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The tolerance to load variations during ELMs of the Ion Cyclotron Resonance Frequency (ICRF) ITER-like antenna (ILA) [1] is achieved by setting the impedance at the internal conjugate T-points to low impedance (~3*Ohm*). When operated in this configuration, arcing occurring around the T-junctions is not detected by the standard Voltage Standing Wave Ratio (VSWR) protection. Consequently, additional arc detection was developed to safely operate the ILA on ELMy H-mode. The SMAD system first described in [2] was implemented on the ILA beginning of 2009 and this paper will summarise its performance.

After initial assessment on testbed and off-line evaluation of SMAD error formulas during initial operation on JET [2], sufficient confidence was gained to deploy a set of 4 SMAD systems on all quarters of the ILA. The system was debugged, commissioned and used extensively during the ILA commissioning and onwards. A large amount of data (~285*GB*) was obtained, as high sampling rate data (2μs) are mandatory to study arc events. The present analysis focuses on JET pulses with the ILA operating at high power and/or under load tolerant conditions and when electrical arcing was detected. The nature of the arc events (position, relation with ELMs,…) are characterized by analyzing the correlation with the VSWR and Sub-Harmonic Arc detection (SHAD [3]) trip signals, the high sampling rate RF data (from different measurements point along the system) and the SMAD error signals.

Finally, although the SMAD system seems capable of protecting against arcs, the data analysed also revealed some shortcomings ("blind" areas, protection series vs parallel arcs). Further testing on the JET A2 antennas and transmission line arc teststands is being considered and might lead to future implementation on the ITER ICRF launchers.

[1] F. Durodie, Fusion Engineering and Design 84 (2009) 1953–1960
[2] M. Vrancken et al., Fusion Engineering and Design D, 84(2009), pp. 1953-1960.
[3] P. Jacquet et al., AIP Conference Proceedings 1187, (2009), pp.241-244.

*See the Appendix of F. Romanelli et al., Proceedings of the 22nd IAEA Fusion Energy Conference 2008, Geneva, Switzerland