FEASIBILITY OF AN ECRH SYSTEM FOR JET : ASSESSMENT OF THE IMPACT ON THE JET DIAGNOSTICS

T. Gerbaud[1], J. Fessey[2], E. de la Luna[3,4], T. Edlington[2], S. Schmuck[5], A. Sirinell[i2]

and JET EFDA Contributors*

JET-EFDA Culham Science Centre OX14 3DB, Abingdon UK.

[1] LPTP, Ecole Polytechnique, 91128 Palaiseau, France
[2] CCFE, Culham Science Centre, Abingdon OX14 3DB, UK
[3] EFDA Close Support Unit, Culham Science Centre, Abingdon OX14 3DB, UK
[4] Laboratorio Nacional de Fusion, Asociacion EURATOM-CIEMAT, 28040, Madrid, Spain
[5] Max-Planck-IPP, Euratom Association, D-17491 Greifswald, Germany

This paper presents a review of the modifications to the JET diagnostic systems that might be demanded by the installation of a 10 MW, 170 GHz ECRH system in JET [1]. As the 170 GHz frequency is present in the measurement band of some systems on JET, it is necessary to identify and analyse the effects that might be caused by that high-power injection. Even if that specific frequency lies not in the measurement band, the power level considered is harmful for microwave components. Following [2], stray radiation caused by ECRH power is assumed to be a few mW in normal operation, and may rise by a factor of 100 to 1000 under fault conditions. For the latter case, as components can usually handle up to 10 dBm (10 mW), a 40 dB rejection at 170 GHz is needed. A very narrow frequency width (~1GHz) is assumed for the 170 GHz source, to take into account any frequency jitter - particularly during switching.

The most concerned diagnostics are operating in the microwave band: Michelson interferometers, ECE heterodyne radiometer and O and X mode reflectometers. For each diagnostic critical optical and microwave components affected by stray radiation have been identified. The considered protections are mainly band rejecting filters in the fundamental – WG26, WG28, WG30 – or oversized – WG10 – waveguides, or mechanical shutters. Protection for non-microwave systems – FIR interferometer, bolometers, and soft X-rays, visible and IR cameras – is also detailed.

Ensuring that data quality is not affected by the ECRH power injection and the appropriate protections is crucial. Band rejection filters will obviously make measurements impossible around 170 GHz, the bandwidth depending on the filter characteristics, and insertion losses might degrade the data quality of the signal measured by reflectometers. For instance measuring the electronic temperature profiles with the ECE systems (interferometers and radiometer) would require to use the O-mode propagation instead of the X-mode one.

As this stray radiation can propagate in small waveguides (dimensions of few mm), the power density (W/m^2) is high enough to cause personal safety issues. Waveguides should not suffer any radiation leakage at 170 GHz and some systems and areas should be physically closed and secured with interlocked access.

[1] M Lennholm, An ECRH system for jet: a feasibility study, this conference.
[2] G. Conway et al, Stray radiation protection of ITER microwave based diagnostics, 2009, RWG-55F-0901

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