ITER fast ion collective Thomson scattering. Conceptual design of 60 GHz system

The collective Thomson scattering diagnostic for ITER at the 60 GHz range is capable of measuring the fast ion distribution parallel and perpendicular to the magnetic field at different radial locations simultaneously. The design is robust technologically with no moveable components near the plasma. The fast ion CTS diagnostic consists of two separate systems. Each system has its own RF launcher and separate set of detectors. The first system measures the perpendicular component of the fast ion velocity distribution. It consists of radially directed RF launcher and receiver, both located in the equatorial port on the low field side (LFS). This system will be referred to by the acronym LFS-BS system referring to the location of the receiver and the fact that it measures backscattered radiation. The second part of the CTS diagnostic measures the parallel component of the fast ion distribution. It consists of an RF launcher located in the mid-plane port on the LFS and a receiver mounted on the inner vacuum vessel wall that views the plasma from between two blanket modules. This system will be referred to as HFS-FS referring to the location of the receivers and that they measure forward scattered radiation. The design of both LFS-BS and HFS-FS receivers is aimed at measuring at different spatial locations simultaneously with no moveable components near the plasma. This report is a preliminary study of the hardware design and engineering constraints for this frequency range. Section 2 conceptually describes the two systems and their main components. Section 3 clarifies the impact of design parameters such as beam widths and scattering angle on the CTS measurements. With this in hand, the ITER measurement requirements are translated into constraints on the CTS system designs. An important result in this section is that systems can be designed inside these constraints. Section 4 outlines the technical feasibility and describes in more detail the design and the engineering constraints of each system. Section 5 briefly describes an upgrade to the CTS diagnostic to permit fuel ion density ratio measurements with the same probe line and system front-end. Finally, Section 6 outlines future work needed to address issues related to the hardware and design.