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ITER RF Systems and diagnostics

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The operation of the ITER fusion machine will rely heavily on the performance of the plasma heating systems and diagnostics system both being essential pre-requisites for the plasma control system.

An extensive diagnostic system will be installed on the ITER machine to provide the measurements necessary to control, evaluate and optimize plasma performance in ITER and to further the understanding of plasma physics. These include measurements of temperature, density, impurity concentration, and particle and energy confinement times. The measurement technologies include magnetics, neutron systems, optical, spectroscopic, bolometry, and microwave systems.

The microwave systems operate in the frequency range from a 5 GHz to 200 GHz and include electron-cyclotron-emission measurements for the main plasma, microwave reflectometers for for plasma position, the divertor plasma, and for the main plasma, as well as the fast wave reflectometry. These diagnostics require microwave sources, transmission systems and receiver covering the whole frequency range.

The ITER Tokamak will rely on three sources of external heating that work in concert to provide the input heating power of 50 MW required to bring the plasma to the temperature necessary for fusion. These are neutral beam injection and three sources of radio frequency heating. RF heating and current drive techniques include ion cyclotron resonance frequency (ICRF, 30-65 MHz), electron cyclotron resonance frequency (ECRF, 170 GHz) and lower hybrid current drive (LHCD, 5GHz) system. The role of RF is not only for bulk plasma heating, but is now essential to optimize both the reference scenario (MHD stabilisation) and the advanced scenarios (current profile control) in ITER. The “unit” power of all the RF systems is 20 MW.

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