

Considerations in Selection of ECH System Transmission Line Waveguide Diameter for ITER

R.A. Olstad, J.L. Doane, R.W. Callis, and C.P. Moeller

General Atomics, P.O. Box 85608, San Diego, California 92186-5608, USA

The reference diameter for the ITER ECH transmission lines is presently 63.5 mm. This value is conservative in that the losses in corrugated waveguide at this diameter are very low at 170 GHz, i.e. only 32 watts/m with 1 MW transmitted. Analyses of the heat generation and removal in 63.5 mm corrugated waveguide components were reported in the previous IAEA technical meeting at Kloster Seeon in 2003 and at the SOFT 2004 conference in Venice. Those analyses concluded that the temperature of all components could be kept to acceptable levels, even with operation at 2 MW cw per transmission line. Recently interest has been expressed in the community about the possible advantages of using a smaller diameter waveguide for ITER, particularly because of limited space available at both the equatorial and upper launchers. In addition to ameliorating the space constraints, there could be large cost savings for a modest diameter reduction in certain transmission line components, particularly gate valves and CVD diamond window assemblies at the entrance to the launchers.

Results of a tradeoff study on ITER waveguide diameter will be reported. Diameters considered range from 45 mm to 63.5 mm; consideration is also given to the possibility of tapering down to 31.75 mm at the launchers. The most critical issue for smaller diameter components is the increased losses and increased power densities. These lead to more demanding cooling provisions and higher operating temperatures for components such as miter bends, power monitor miter bends, bellows, dc breaks, waveguide switches, and waveguide sections adjacent to miter bends. In addition, the overall transmission efficiency of the ITER transmission lines would be reduced, with lower power delivered to the plasma for a given gyrotron output power.

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