Progress on corrugated waveguide components suitable for ITER ECH&CD transmission lines

R.A. Olstad, R.W. Callis, M. Cengher, J.L. Doane, Y.A. Gorelov, H.J. Grunloh, C.P. Moeller and C.J. Murphy

Abstract

The 2 MW cw requirement for ITER EC transmission lines has led GA to design a number of new and modified components, namely power monitors and polarizers to meet this requirement. In addition, the ITER transmission lines may require sliding joints or bellows to accommodate the thermal expansion of the lines and/or vessel motion. The ex-vessel sections of the EC launchers require double seal waveguides, miter bends and possibly double seal sliding joints to assure tritium retention in this region. GA has developed designs for many of these components and some of them have already been tested at high power at the JAEA RF Test Stand. Thermal analyses of the standard GA power monitor miter bend show that our standard design is suitable for 1 MW cw operation when the H-field is in the plane of the miter bend. For 2 MW cw operation a modified design, which also requires H-plane orientation, has been developed and a prototype has been fabricated and is ready for testing. For long pulse/cw operation, a 2 MW calorimetric miter bend with thermally isolated mirror has been designed and a prototype has been fabricated. Since the mirror is thermally isolated, calorimetry on the mirror cooling water can provide a measure of absorbed power. Such a miter bend, when made in a double seal version, could be useful for monitoring total power at the end of an EC transmission line just before the in-vessel section of an EC launcher. A mode analyzer using an all metal water-cooled beam splitter is being developed for use in measuring in real time the HE_{11} and higher order mode content or total power in EC transmission lines. Such a high power diagnostic can be very useful in optimizing the alignment of the MOU output into a transmission line and in monitoring the HE_{11} mode purity at various locations in a transmission line. Prior to making a 63.5 mm 170 GHz version suitable for use on ITER, several prototype 31.75 mm 110 GHz versions have been fabricated and tested at DIII-D. A 170 GHz version is now being fabricated. This paper addresses the performance characteristics, design features and test results for the new and modified components being developed to assure low loss transmission and acceptable component stresses for 2 MW cw operation.