Transmission Line Performance and Plans for the Gyrotron Complex on the DIII-D Tokamak

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***Abstract*— The gyrotron complex on the DIII-D tokamak is being upgraded. A seventh gyrotron at 110 GHz, with designed output power of 1.2 MW for 10 s pulses, will be added to the system at the end of 2011 and the design of another gyrotron operating at 117.5 GHz, generating 1.8 MW for short pulses and 1.5 MW for pulse lengths ~5 s, which are typically used for DIII-D experiments, has been completed by Communications and Power Industries. The high voltage power supplies and the controls and transmission lines for these gyrotrons are being installed. A fourth dual launcher for DIII-D is being supplied by Princeton Plasma Physics Laboratory. Rerouting the transmission lines reduced the number of miter bends per line; and improved alignment of the rf beams to the waveguides has increased the fraction of $HE_{1,1}$ in the waveguides to 94.4% in the best case. The pointing accuracy and slewing speed of the steering mirrors were improved and additional interface capability between the DIII-D plasma control system and the electron cyclotron heating (ECH) system controls was added. A design for low diffraction miter bends, which relies on generating a controlled mode mixture to narrow the rf beam at the miter mirror, was tested. These miters will substantially reduce the mode conversion losses in the miters, but tests showed that the fraction of $HE_{1,1}$ fundamental mode in the lines needed to be increased to realize the performance improvement. This work is continuing. Calibrated injected power figures, based on directly measured high power transmission line measurements and gyrotron cavity calorimetry, are available for the gyrotron systems on each plasma shot. A beamsplitter miter has been developed which allows polarization and mode content measurements to be made at high power. These developments and a synopsis of experiments being performed using the ECH system will be presented.**

This work was supported by the US DOE under DE-FC02-04ER54698 and DE-AC02-09CH11466 and General Atomics internal research and development funds.