PROGRESS OF THE UPGRADE TO THE DIII-D GYROTRON COMPLEX*

J. Lohr[1], *Y. Gorelov, K. Kajiwara, D. Ponce, J. Tooker, R. Callis, R. Ellis*[2]

[1]General Atomics, P.O. Box 85608, San Diego, CA, 92186-5608 USA
[2]Princeton Plasma Physics Laboratory, Princeton, NJ, USA

First Author e-mail: lohr@fusion.gat.com

The gyrotron complex on the DIII-D tokamak [1] is receiving a major upgrade. Three long pulse gyrotrons [2] and one developmental prototype depressed collector gyrotron [3] are being installed and one of the DIII-D dual launcher assemblies is being replaced with a launcher capable of real time fast scan of the rf beam trajectory in the tokamak poloidal plane. All the gyrotrons, the production units and the prototype, operate at 110 GHz. The production tubes have nominal rf output of 1.0 MW for up to 10 s pulse length at rf efficiency of about 30% and the prototype single-stage depressed collector tube has demonstrated 1.3 MW for short pulses at about 42% efficiency. The new production gyrotrons differ from the previous group of three which have been in service for several years by the addition of two vacion pumps, operating in the main magnetic field, pumping the mirror box region and the incorporation of an improved output window support structure.

The real time scannable launcher is designed to provide 10 deg/s scan for long travel and 100 deg/s for about ±2 deg scans to enable the rf deposition position to track the shifting resonant flux surfaces for NTM suppression during evolution of discharges leading to high beta. The scan can be controlled by the plasma control system in response to changes in equilibrium or other plasma characteristics such as MHD activity or current density profile.

Additional improvements to the DIII-D installation include the calorimetric measurement and archival of gyrotron power loading and rf production data for every plasma shot and additional temperature measurements on the outside surfaces of the gyrotron collectors. The requirement for additional collector diagnostics was stimulated by the thermally induced stress failures of all three of the current production gyrotron collectors. Thermal modeling will permit the collector vacuum wall temperature to be inferred from outside surface measurements. The range of the electron beam sweep over the collector is being increased to reduce the peak power loading. A sweep waveform is being developed using bipolar sweep coil power supplies, which will minimize the dwell time of the electron beam at the bottom of the collector where the footprint is smallest and the failures have occurred.

The final system will generate over 5 MW for operational pulse lengths of 5.0 s with transmission line efficiencies of about 80%. Two spare gyrotrons will be available.

References

[1] John Lohr, et al., Fusion Science and Technology, **48**, 1226 (2005).
[2] K. Felch, et al., Proc. 12th Joint Workshop on Electron Cyclotron Emission and Electron Cyclotron Heating, G. Giruzzi, ed., (World Scientific, Singapore, 2002) p. 565.
[3] S. Chu, et al., Proc. 5th IEEE Intl. Vacuum Electronics Conf., Monterey, California (2004).

*Work supported by the U.S. Department of Energy under DE-FC02-04ER54698.