Progress Report on the DIII-D ECH System

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Abstract—The expansion and upgrading of the electron cyclotron heating (ECH) gyrotron complex on the DIII-D tokamak are continuing with the addition of the first of a series of depressed collector tubes in the 1 MW class. The first two of these tubes operate at 110 GHz and are designed for 1.2 MW generated power. One of these is now in operation at DIII-D and the second should be delivered in mid-2013. Although the first of these gyrotrons have generated 950 kW, rather than 1.2 MW, conditioning to 5 s pulse length at full parameters was rapid, the beam quality is excellent and the overall operational performance has been very good. An issue with collector cooling is being investigated. The following group will operate at 117.5 GHz and are designed to generate 1.5 MW for operational pulse lengths. The first of these 117.5 GHz tubes is being manufactured and should be delivered late in 2013. The pulse length specification is 10 s for all the gyrotrons in the DIII-D system, providing a match to the capability of the tokamak. The real time poloidal scan capability of the DIII-D launchers is being exercised for experiments while it is being upgraded. The full 40º poloidal scan can be covered in 700 ms and this is being upgraded by installation of motors with three times higher speed, that are now under test. Magnetic encoders are being tested to replace the 14 bit electro-mechanical encoders, which had originally been intended for much slower readback speeds, and suffered from contact bounce issues at the higher scan speeds now being used. A second reliquifier has been added so that the liquid helium requirements for the remaining gyrotron magnet with a liquid helium reservoir will be greatly reduced. No makeup liquid helium has been required for the first unit to be equipped with a reliquifier except when problems with either the electrical grid or water-cooling system occurred. In these cases, the excess capacity of the reliquifier was used to refill the magnet from bottled helium gas. The operating system is being upgraded with FPGA-based fault processing and enhanced communications between the DIII-D Plasma Control System and the ECH control system. A summary of experiments performed with the system during the 2013 campaign will be presented. This work was supported by the US DOE under DE-FC02-04ER54698 and DE-AC02-09CH11466.