INSTALLATION, FEATURES AND CAPABILITIES OF THE DIII–D ADVANCED TOKAMAK RADIATIVE DIVERTORS*

R.C. O'Neill, A.S. Bozek, M.E. Friend, C.B. Baxi, E.E. Reis, and M.A. Mahdavi

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

The DIII–D program has recently completed the installation of a third cyropump and divertor structure. DIII–D's three cryopumps and extensive diagnostics have permitted experiments to investigate density control and plasma core confinement this past year. These experiments were designed to investigate the performance of baffled and open divertors in both single- and double-null plasmas. The experiments utilized all three of the DIII–D radiative divertors located in the lower outer radius, the upper outer radius, and the upper inner radius of the vessel, the last of which was installed late last year.

Each divertor consists of a cryo/helium cooling ring and a shielded protective structure. The divertors were designed to optimize pumping performance and to withstand the electromagnetic loads from both halo currents and toroidal induced currents. Incorporated also into the structures is the capability to withstand the thermal gradient across the structures and the DIII–D vacuum vessel during operations and bakeout, during which temperatures reach as high as 350°C. The protective structure provides baffling of neutral charged particles and minimizes the flow of impurities back into the core of the plasma. The structures, consisting of water or radiatively cooled panels, allow for the attachment of various sizes and shapes of graphite tiles. The various sized tiles, which can be quickly removed and installed, allow for the overall geometry of the divertor to be modified to increase the divertor slot length and width. This hardware permits either single- or double-null plasma experiments and enables continued research of well confined high beta divertor plasmas with noninductive current drive, which is one of the main research goals of DIII–D.

Contained within the protective or baffle structure and the tile arrays of each divertor are gas puff systems. The gas puff systems provide nearly axisymetric injection of both D_2 and impurity gases for experiments on radiative divertors, gas feeding and impurity entrainment.

The other critical components of the divertor structures are the cryo/helium-cooled pumps, which exhaust particles from the plasma. The pumps, with theoretical pumping speeds varying from 15,000 to 32,000 ℓ/s, in conjunction with the baffle structures, collect particles and prevent them from recirculating back into the plasma core. The particles are then removed from the cryopump surfaces and exhausted from the vessel by allowing the pumps to warm slightly during the glow discharges between the plasma shots. Having two pumps in the top two quadrants of the vacuum vessel allows for pumping both the outer strike point region and either the inner strike point or private flux region.

With this unique capability of pumping and injection of gases, various diagnostics are used to further understand impurity transport and plasma flows. The diagnostics are positioned in and around each divertor to monitor the scrape-off layer, plasma and separatrix. Utilizing these diagnostics allows for the measurement of the capabilities and performance of the divertors, which is discussed in this paper along with the designs and features of the structures.

*Work supported by U.S. Department of Energy under Contract No. DE-AC03-99ER54463.