LAUNCHER PERFORMANCE AND THERMAL CAPABILITY OF STEERABLE MIRRORS IN THE DIII-D ECH SYSTEM*

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The DIII-D ECH system uses three launcher assemblies, each of which can inject rf power from two gyrotrons. Poloidal and toroidal steering is provided using movable mirrors of different designs to direct the rf beams. Eddy current induced forces arising during disruptions are particularly problematic for the actuator assemblies on the movable mirrors, which have limited ability to react the forces. Therefore, mirror designs which minimize the volume of high conductivity copper while maintaining low resistivity reflecting surfaces have been developed. The mirrors are radiatively cooled, leading to a requirement to evaluate the thermal performance of the three different mirror designs for the expected maximum rf energy, 800 kW, 10 s. pulses at 1% duty cycle. This has been done theoretically and experimentally. One mirror, the "GA mirror" is made from Glidcop, with a thick center providing thermal inertia and thin periphery, reducing disruption forces. This mirror is grooved and blackened on the back to increase radiative cooling. A second mirror is made from graphite with a molybdenum reflecting surface brazed to it. This design, called the "PPPL mirror," significantly reduces eddy currents and easily withstands the disruption forces. However, the surface temperature is higher than the GA mirror because of the higher resistivity of molybdenum. Therefore, the pulse length is limited to 5 s. The third mirror design is called the "butcher block" mirror, which has a sandwich structure of Glidcop and stainless steel. The reflecting surface in this mirror is a thin Glidcop layer supported by the sandwich. This design has the best overall performance of the three and meets the power, pulse length and duty cycle requirements. The launchers are monitored by a set of diagnostics. Each dual launcher has 10 resistance temperature devices (RTDs), two Langmuir probes and two camera ports. Four of the RTDs are attached to the backs of the steerable mirrors. The other six RTDs are mounted to the fixed focusing mirrors and the launcher waveguides. Fiberoptically coupled video is used to detect launcher arcing and this video is recorded for each plasma shot. One Langmuir probe is mounted near each launcher waveguide, providing redundant arc detection. The mirror performance and launcher diagnostics will be described.

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