OPTIMIZED BAKING OF THE DIII–D VESSEL*

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The DIII–D tokamak vacuum vessel baking system evolved from the inductive heating system used on DIII between 1979 and 1984. This system is used to heat the vessel and internal hardware to an average of 350°C for outgassing and vessel conditioning purposes in order to prepare it for operation with high temperature tokamak plasmas. The DIII–D vessel contains about 2000 Kg of graphite plasma facing protective tiles that absorb moisture and gasses during vessel open periods and deuterium during plasma operations. Reducing levels of water and oxygen lowers radiation loss during operation. Reducing the deuterium background improves density control during plasma operations allowing the low density operation that is required for enhanced plasma performance regimes. Heating graphite to about 350°C has been shown to accelerate vessel conditioning significantly. The ability to rapidly heat, hold steady temperature and rapidly cool down, even on an overnight basis, is beneficial to condition the vessel, remove injected trace gasses, or reduce deuterium levels for helium leak checking.

The DIII–D vessel baking system has not been modified since it was first used in early 1986. Since that time the thermal mass has increased about 50% due to added vessel armor tiles, divertor hardware, ICH launchers, etc. Minor changes in the baking system were made to heat the divertor hardware. These changes have occurred gradually and have resulted in a slow increase in time to 350°C average from around 9 hours in 1986 to 14 hours in 1998.

The Inconel vessel is heated primarily by inductive eddy currents developed in the vessel walls by the ohmic heating system. The inductive system produces an inherently uneven temperature distribution throughout the vessel. Compressed air flows in poloidal paths in the corrugated walls of the double walled vessel to develop a more uniform temperature distribution. Reasonable temperature uniformity is required to limit thermal stresses to acceptable values and to produce good baking results.

An evaluation of the baking system was recently initiated to evaluate the extended time required to attain full temperature of 350°C. This evaluation indicated that the added mass of in-vessel hardware along with the increased emissivity of the graphite covered walls, has changed system requirements so that the baking operation is no longer matched to the system requirements.

Work has started to evaluate reduced compressed air flow rates in order to lower its cooling effect on the vessel. An electric air heater will be installed to boost the inlet air temperature from 250°C to near the 350°C baking temperature. These changes, along with optimized baking procedures, are expected to reduce the time to 350°C vessel average from 14 hours to 6 hours while developing more uniform temperatures throughout the vessel. This paper will report on this improved baking program and its effect on vessel and vessel port temperatures, vessel conditioning and base pressure.

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