

DESIGN, FABRICATION, INSTALLATION, TESTING AND INITIAL RESULTS OF IN-VESSEL CONTROL COILS FOR DIII-D*

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Since 1995, DIII-D has performed correction of magnetic field imperfections using a set of six external picture frame coils located on the vessel mid-plane. In 2000, these coils also demonstrated benefits when used for feedback of the resistive wall mode, an instability that limits the plasma performance at high beta. Modeling has shown that substantial performance improvements could be achieved by installing new coils inside the vessel and expanding the poloidal coverage above and below the mid-plane. Two prototype internal coils were installed in 2001 and were power tested successfully after several bakes to 350°C. A full set of twelve internal coils and related magnetic sensors were installed in late 2002 and are now operational in the DIII-D tokamak. The design requirement for the new coil system was to maximize the magnetic field at the plasma edge, operate with a frequency range of dc to 1000 Hz, and fit behind the existing graphite wall tiles. The coil design adopted and installed is a water-cooled single turn hollow copper conductor insulated with polyamide and housed inside a stainless steel tube that forms a vacuum boundary. The coil is rigidly mounted to the inside of the vacuum vessel. The primary challenge in the design of these coils was in joining of both the copper conductor and the stainless tube without overheating the polyamide insulator. Elastic-plastic analysis was used to demonstrate acceptable thermal stresses during baking conditions. Analysis determined the optimum water cooling channel diameter. The coils were tested in high toroidal field to the limit of the power supply of 4.5 kA DC with inductance-limited current for frequencies between 300 Hz and 1000 Hz. Recent results will be presented.

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