THERMAL ANALYSIS AND TESTING FOR DIII–D OHMIC HEATING COIL REPAIR*

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The DIII–D ohmic heating (OH) coil consists of two parallel windings of 48 turns each cooled by water. Each winding is made up of four parallel conductors. A lead on one of the conductors started leaking in July 1995. A finite difference computer program was developed to determine if the OH coil could be operated without cooling the leaking segment, by relying on conduction heat transfer from the neighboring cooled conductors. The formulation took into consideration the transient momentum and energy equations, including the effect of conduction between neighboring channels. The axial conduction was modeled in the conductor, but was ignored in the coolant. A semi-implicit numerical scheme was used to solve the equations.

A thermal experiment was performed on the OH coil to determine the thermal conductance between neighboring conductors. The experiment was done on a coil bundle with undamaged leads. The experiment consisted of passing hot water through adjacent cooling channels of two conductors and cold water through cooling channels of the remaining two conductors of the same winding. The flow, inlet and outlet temperatures from each circuit were measured during the transient. The experiment was run until steady-state was reached, which took about 30 minutes.

From the experimental data and utilizing the computer program described above, thermal conductance between the conductors was calculated to be about 0.1 W/cm^2-C, close to the estimated value. It was also observed that there is some heat transfer to the second solenoid winding.

Using the experimentally determined value of the thermal conductance, an analysis was performed on a coil bundle consisting of one uncooled conductor and three cooled conductors. Results show that it is possible to operate the OH coil without cooling the section with the damaged lead to the desired I^2t per pulse of 6.7×10 A^2-s. The cool down time is about 10 minutes.

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