# THERMAL ANALYSIS AND PERFORMANCE OF THE LOWER DIVERTOR FOR DIII-D

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The lower divertor of the DIII-D tokomak was replaced to provide improved density control of the tokomak plasma during operation in a balanced double null configuration. The divertor is also used during single-null diverted plasmas. This divertor replaces the much smaller Advanced Divertor installed in 1990. The lower divertor was put into operation in May 2006.

The primary structural component of the lower divertor is a torridly continuous flat annular ring plate. The plate is water-cooled for heat removal and can be heated with hot air for baking during vessel conditioning. Three rows of graphite tiles are mechanically attached to the plate to shield it from plasma impingement. The through tile-face bolt holes have been eliminated from graphite tiles in areas of high heat flux in order to avoid excessive erosion caused by plasma impingement on the edges of bolt holes.

The mechanically attached tiles are machined from Union Carbide TS1792 graphite. Finite element thermal analysis was done to predict the temperature and thermal stresses during and after a plasma shot. Localized heat loadings up to 10 MW/m sq. were specified for shots with durations as long as 10 seconds followed by 600 seconds between shots. The mechanically attached tiles are inertially cooled between shots. The goal of the design was to produce tiles that would have acceptable thermal stress if the tile surface reached ablation temperature. Peak thermal stresses are affected significantly by variations in tile geometry and gradients in energy deposition.

The thermal performance of the new divertor tiles is monitored by thermocouples located in individual tiles and an IR camera. Heat removal from the entire divertor is determined by water temperature and flow measurements.

This paper compares the theoretical FEA analysis and the measured performance during tokomak operation. To the extent possible, the thermal evaluation will include test results from a rastered electron beam test facility.

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