**Improved Langmuir Probe Array for DIII-D***

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Langmuir probes are commonly used plasma diagnostics measuring localized near-wall plasma potential, electron temperature, particle flux, and electron density. They typically consist of electrodes slightly protruding into or near the plasma and driven with an oscillating potential. The resulting electrical current data is analyzed to infer plasma properties. A major upgrade of the DIII-D lower divertor required an improved design of Langmuir probe arrays to accommodate the higher heat fluxes in the new divertor plasma facing components. It was also advantageous to decrease the linear space between probe tips and improve maintenance functions.

The previous Langmuir probe design consisted of a cylindrical graphite probe with domed tip, which would be unable to handle the higher operational plasma heat fluxes required of the new divertor. Insufficient thermal mass distributed the intercepted heat flux non-uniformly over the surface. Computational thermal analysis resulted in an improved design utilizing longer pyrolytic graphic probes with an optimized rooftop probe-tip shape and a much larger thermal mass. The new probe tip distributes the heat flux more uniformly over the fixed angle, roof-top shaped surface. The advanced design features an increased thermal mass of thirteen fold and half the peak heat flux. Thermal coupling of the probe to the surrounding tile was greatly enhanced by increasing the thermal contact area. A novel probe mounting system has the entire probe array supported in a single tray. The high-density array configuration allows a halving of the probe array spacing. The probe array mounting system compensates for thermal expansion from operation and bake-out. The system allows for probe replacement by removing an individual tile and a single screw leaving the cabling, adjacent probes, and mounting tray undisturbed, thereby simplifying probe maintenance and potential complications with adjacent hardware.

After an annual operational period, the probes yielded reliable data and showed little or no erosion. The only distinguishable erosion was found on two probes in the highest heat flux region. This erosion was within expected tolerances and was insufficient to significantly change the projected plasma area of the probe, and thus maintaining probe signal integrity.

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