Plasma Operation and Monitoring of Wall Conditions on DIII-D Over Extended Periods Between Boronizations*

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During the 2006 and 2007 DIII-D experimental campaigns the time between boronization (BZN) events was increased to <7000 plasma seconds with no detrimental effects on discharges, including that of high performance hybrid and advanced tokamak discharges. During previous campaigns, the time between BZN events was roughly 1000 plasma seconds. The 2006 and 2007 campaigns were both preceded by entry vents for in-vessel maintenance and upgrades, the duration of these vents were 1 year and 6 weeks respectively. At the beginning of each campaign the DIII-D plasma-facing surfaces were conditioned with the usual baking at 350°C followed by plasma operation with significant heating power. In 2006 a BZN was completed prior to the start of physics experiments, while in 2007 two weeks of physics experiments were successfully completed prior to a BZN. A standard reference discharge was used to monitor long term changes in plasma impurity content and particle wall sources. Emission from core, edge and divertor impurities was recorded on a daily basis, along with gas fueling, exhaust, and core particle content. Over three month periods in both campaigns no secular trends were observed in impurity line emission during the H-mode phases. Small secular increases in the L-mode core carbon and nickel emission were observed in the early part of the campaigns, but these increases appeared to saturate after about a month of operation. After 3 months of the 2006 campaign, or ~7000 plasma-seconds, a second BZN was performed to determine its influence on plasma performance. Sudden changes were observed in core and divertor impurity line emissions, but they returned to the pre-BZN levels after a brief period of plasma operation. During the 2007 cleanup period following the entry vent, reference shot data indicated the initially high impurity line emission had returned to levels very similar to those observed at the end of the 2006 campaign.

At several times throughout the 2006 and 2007 campaigns high performance hybrid and advanced tokamak (AT) discharges were carried out using very similar operational parameters. These shots were frequently executed as a part of an experimental day as a benchmark for comparison of new results. Hybrids, operating in a stationary state with a normalized beta of 2.7 and an ITER89P H-factor of 2.4 were very repeatable throughout this period, including at the end of the cleanup period prior to the BZN in 2007. The AT discharges, with a peak normalized β_N of 3.8 and an H-factor of 3.0 were also very repeatable. Details of core and divertor impurity spectroscopy, radiated power, wall fueling and uptake, along with the implications for the robustness of high performance operation in an all-carbon wall, long-pulse device, will be discussed.

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