Review of DIII-D H-mode density limits studies

R. Maingi[a] and M.A. Mahdavi

General Atomics, P.O. Box 85608, San Diego, CA 92186-5608, USA

[a]Oak Ridge National Laboratory, PO Box 2009, Oak Ridge TN, 37831, USA

Contact author: R. Maingi, Oak Ridge National Laboratory, PO Box 2009, Oak Ridge TN, 37831, Phone (609) 243-3176, e-mail: rmaingi@pppl.gov

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Abstract. Density limit studies over the past 10 years on DIII-D have successfully identified several processes which limit plasma density in various operating modes. The recent focus of these studies has been on maintenance of the high-density operational window with good H-mode level energy confinement. We find that detachment and onset of multi-faceted axisymmetric radiation from the edge (MARFEs), fueling efficiency, particle confinement, and magnetohydrodynamic activity can impose density limits in certain regimes. By studying these processes, we have devised techniques with either pellets or gas fueling and divertor pumping to achieve line average density above Greenwald scaling, relying on increasing the ratio of pedestal to separatrix density, as well as density profile peaking. The scaling of several of these processes to next step devices (e.g. the International Thermonuclear Experimental Reactor) has indicated that sufficiently high pedestal density can be achieved with conventional fueling techniques while ensuring divertor partial detachment needed for heat flux reduction. One density limit process requiring further

study is neoclassical tearing mode (NTM) onset, and techniques for avoidance/mitigation of NTMs need additional development in present day devices operated at high density.

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