Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

1D study of thermal instability caused by plasma-wall interactions[1] I.V. DOBROVOLSKAIA, S.I. KRASHENINNIKOV, A. YU. PIGAROV, UCSD — Based on simple 0-D model in Ref. [1] it was shown both analytically and numerically that the interactions of plasma with first wall saturated with hydrogen can cause thermal instability resulting in massive desorption of gas from the wall. In a tokamak it can lead to the formation of MARFE, transition to detachment, or even disruption. The physics of this instability is related to the positive loop associated with an increase in neutral desorbing rate with increasing wall temperature and the further increase of wall temperature caused by an increase of heat flux to the wall caused by charge exchange and radiation loss of plasma energy. In the paper, we refine and extend the model from Ref. [1] by using 1D approximation for plasma particle and energy transport, neutral hydrogen transport in plasma, wall energy balance, and hydrogen desorption processes. We analyze both stability condition and growth rate of thermal instability and compare our results with both 0D model from Ref. [1] and available experimental data. We also discuss possible implications of such thermal instability for steady-state operation conditions in ITER. [1] S. I. Krasheninnikov and T. K. Soboleva, "Thermal instability caused by plasma-wall coupling", to appear in Phys. Plasmas 2006.

[1]The work was performed under auspices of the U.S. Department of Energy by UCSD under grants Nos. DE-FG02-04ER54739.

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Date submitted: 31 Jul 2006 Electronic form version 1.4