Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

Some Divertor Scaling Considerations[1] P.C. STANGEBY, University of Toronto — A case is advanced for "divertor non-scaling", viz that absolute values of divertor density $n_d \sim 10^{21}$ m^{-3} and temperature $T_d \sim 5$ eV need to be achieved for optimal demo/reactor-relevant studies. For $T_d > 10$ eV sputtering is very strong; for $T_d < 2$ eV there is risk of detachment and density limit. High n_d is required for high power, high duty cycle devices so that net erosion $\ll$ gross erosion via prompt local re-deposition of sputtered material. This occurs when impurity neutral ionization mean free path $\ll$ fuel ion gyro-radius (magnetic pre-sheath thickness); for $B \sim$ 5 T this requires $n_d \gtrsim 10^{21}$ m^{-3}. Thus peak parallel power flux density $\sim 0.1 - 0.5$ GW/m^2. Modified two-point modeling then gives that: (a) "upstream" (e.g. outside midplane, separatrix), conditions, n_{eu}, T_u, are almost fixed, independent of R (device size) and P_{SOL} (power entering the SOL), and (b) the required $P_{SOL} \sim R^1$, $R^{1.5}$ or R^2, depending on assumptions about target power width; the latter are discussed. A test device with these absolute n_d, T_d values will reproduce the most critical edge aspects of demo/reactors including power handling and material erosion/migration.

[1]Work supported by the NSERC DG and the US DOE under DE-FC02-04ER54698.

P.C. Stangeby
University of Toronto

Date submitted: 22 Jul 2009 Electronic form version 1.4