

**Abstract Submitted for the 51st Annual Meeting
Division of Plasma Physics
November 2–6, 2009, Atlanta, Georgia**

Some Divertor Scaling Considerations,* P.C. Stangeby, *U. Toronto* — A case is advanced for “divertor non-scaling”, viz that absolute values of divertor density $n_d \sim 10^{21} \text{ m}^{-3}$ and temperature $T_d \sim 5 \text{ eV}$ need to be achieved for optimal demo/reactor-relevant studies. For $T_d > 10 \text{ eV}$ sputtering is very strong; for $T_d < 2 \text{ eV}$ 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 $B \sim 5 \text{ T}$ this requires $n_d \gtrsim 10^{21} \text{ m}^{-3}$. Thus peak parallel power flux density $\sim 0.1\text{--}0.5 \text{ GW/m}^2$. Modified 2-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 $P_{\text{SOL}} \sim R^1$, $R^{1.5}$ 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.

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