Application of dimensionless parameter scaling techniques to the design and interpretation of magnetic fusion experiments

T C Luce,[1] C C Petty,[1] and J G Cordey[2]

[1]General Atomics, P.O. Box 85608, San Diego, California 92186-5608

[2]UKAEA Fusion, Culham Science Centre, Abingdon, Oxfordshire, OX14 3DB

(Received

Abstract. A review of the application of dimensionless parameter scaling techniques to magnetic fusion experiments is presented. Because the methods of this type of analysis are not generally known, a detailed discussion of the basis for these techniques is given, including examples. The primary applications and successes of these methods in magnetic fusion research are in the area of transport of energy and particles across the magnetic field lines. The experimental justification for the use of these techniques to describe transport is given, and the applications are reviewed. The two key applications of these techniques, the identification of the underlying physical mechanisms that cause transport and the projection of the transport in future devices from present-day experiments, are extensively discussed. Comparison of the results of dimensionless parameter scaling experiments with the regression analysis of multi-machine databases points to limitations in the databases and the analysis of them as the source of the discrepancies. These discrepancies have significant implications for the design optimization of tokamaks, which are discussed here. Finally, the application of dimensionless parameter scaling

techniques to plasma stability, to the boundary region between closed and open field lines, and to divertor operation in the open field line region are reviewed and discussed.

PACs Nos. 52.55.Dy, 52.30.Ex, 52.25.Fi