Contribution ID: **507** Type: **Poster**

Compact Fusion Energy based on the Spherical Tokamak

Wednesday, 19 October 2016 08:30 (4 hours)

Tokamak Energy Ltd, UK, is developing spherical tokamaks (STs) using High Temperature Superconductor (HTS) magnets as a route to fusion power based on high gain, small size power plants. The paper presents an overview of the continuing advances in technology and modeling, which, together with key engineering developments, support this concept. The ST achieved recognition as a high beta plasma research device with many desirable properties. To date it has been shown to be viable as a compact fusion neutron source /Component Test Facility, but not as a viable route to fusion power because of the inefficiency of driving high current in a slender copper centre column. However, significant new advances change the situation substantially. In particular the latest YBCO High Temperature Superconductors (HTS) are now proven to be able to carry large currents in strong magnetic fields in a very compact centre post. Innovative designs of neutron shielding indicate that relatively thin shields could give sufficient protection to an HTS core under significant neutron bombardment, and new engineering designs of the HTS centre column indicate tolerable stresses. Further, recent modeling has shown that, under reasonable operating conditions, tokamak pilot plants and reactors have a power gain Qfus that is only weakly dependent on size, but depends on fusion power as Qfus ˜ Pfus H2 where H is the confinement factor relative to ITER empirical scalings. For several reasons - including use of a beta-independent confinement scaling demonstrated as being more appropriate than the IPB98y2 scaling - STs should achieve a specified Qfus at considerably reduced Pfus, reducing wall and divertor loading. These innovations introduce the possibility of a superconducting ST Pilot Plant which can be much smaller than the designs previously considered. An example is given of a low-cost compact fusion pilot plant based on an ST of major radius 1.35m and fusion power 150-200MW with Qfus = 1-10, dependent on the confinement achieved. Higher gain versions would be developed from the insight gained and a fusion power plant would then consist of 10 or so of these modules. This approach offers significant advantages, not least that the small scale of the prototype modules should lead to rapid development at relatively low cost.

Paper Number

EX/P3-36

Country or International Organization

United Kingdom

Primary author: Mr SYKES, Alan (Tokamak Energy Ltd)

Co-authors: Dr COSTLEY, Alan (Tokamak Energy Ltd); Dr HUANG, Bill (Tokamak Energy Ltd); Dr WINDSOR, Colin (Tokamak Energy Ltd); Dr KINGHAM, David (Tokamak Energy Ltd); Prof. SMITH, George (Department of Materials, University of Oxford); Dr MORGAN, Guy (Culham Electromagnetics Ltd); Dr CONNOR, Jack (Tokamak Energy Ltd); Prof. HUGILL, Jan (Tokamak Energy Ltd); Dr GRYAZNEVICH, Mikhail (Tokamak Energy Ltd); Dr

NOONAN, Paul (Tokamak Energy Ltd); Dr BUXTON, Peter (Tokamak Energy Ltd); Dr CHUYANOV, Valery (Tokamak Energy Ltd); Dr SHEVCHENKO, Vladimir (Tokamak Energy Ltd); Dr KRIVCHENKOV, Yuri (Tokamak Energy Ltd)

Presenter: Dr COSTLEY, Alan (Tokamak Energy Ltd)

Session Classification: Poster 3

Track Classification: EXS - Magnetic Confinement Experiments: Stability