IAEA FEC 2014

Contribution ID: **541** Type: **Overview**

DIII-D Research to Address Key Challenges for ITER and Fusion Energy

Monday 13 October 2014 12:00 (25 minutes)

The DIII-D tokamak has addressed key challenges in preparation for ITER and the next generation of fusion devices. The robustness of RMP-ELM suppression was demonstrated using as few of 5 of the usual 12 coils. QH mode was extended to 80% Greenwald density fraction, establishing its viability for ITER. Disruption mitigation led to relatively symmetric non-localized heat loads, while vertical displacement events were better ameliorated by earlier mitigation. Real time ray tracing and spectral mode identification techniques enabled more efficient tearing mode control. Promising candidates for steady state (SS) fusion were demonstrated, with a fully non-inductive hybrid scenario, a sustained high l_i scenario for ITER's SS goal, a high q_{min} scenario with high β_N potential, and an 80% bootstrap scenario for EAST. Innovative boundary solutions were implemented with good performance achieved using a radiative divertor in ITER baseline and SS scenarios, and adapting snowflake divertor to the SS to further reduce heat flux. New divertor Thomson scattering enabled real time dual detachment/core density control, and characterized detachment in 2-D. Scrape off layer (SOL) profiles exhibited a critical gradient behavior consistent with ideal ballooning limits, while increasing connection length broadened the SOL and lowered divertor heat flux, highlighting the importance of cross-field transport. Low Z gas injection was found to help prevent erosion of high Z plasma facing surfaces. Underpinning this, DIII-D continued to expand the scientific basis of fusion for projection and optimization of future devices. Transport studies characterized turbulence in electron heated regimes to constrain predictive models of burning plasmas, and showed how long wavelength turbulence rises, with transitions from ITG to TEM increasing particle transport and density peaking. Fast ion transport due to Alfvénic modes was found consistent with a critical gradient model, while 3-D fields led to losses even over a single fast ion orbit. H-mode pedestal structure measurements highlighted the need for kinetic effects in full f simulations, while optimization of the pedestal exploited a predicted valley of improved stability to raise performance.

Work supported in part by the US DOE under DE-FC02-04ER54698, DE-FG02-89ER54297, and DE-AC02-09CH11466.

Country or International Organisation

USA

Paper Number

OV/1-4

Author: Mr BUTTERY, Richard J. (USA)

Presenter: Mr BUTTERY, Richard J. (USA)

Session Classification: Overview 1

Track Classification: OV - Overviews