



Contribution ID: 673

Type: **Overview Poster**

OV/4-5: Science and Technology Research & Development in Support to ITER and the Broader Approach

Monday 8 October 2012 14:00 (4h 45m)

Magnetic Fusion Energy has now entered its development era that steers the activities of traditional fusion laboratories. Recent achievements in fusion science and technology in support to both the ITER and the Broader Approach (BA) projects are reported here. On top of the direct contribution to ITER and JT-60SA procurement packages, many scientific activities, aiming at reducing risks in operation of ITER and BA, have been carried out using the CEA dedicated in-house facilities (Tore Supra tokamak, ICRH test facility for ITER, remote operated diagnostics, actively cooled PFC qualification, cryogenics test facilities from strand to sub size superconducting conductors characterization, etc).

The paper reviews the research and development actions taken in the past two years by CEA in this context, in order to ensure an ITER safe operation (quench detection, disruption mitigation, surface monitoring of plasma facing components), qualify the long pulse RF Heating and Current Drive systems, and progress in MHD, turbulence and transport first principle simulations.

A fully documented project, turning Tore Supra into a long pulse actively cooled diverted plasma test facility, is now being proposed to the ITER partners. This evolution allows the R&D and commissioning tests of actual ITER actively cooled tungsten divertor elements under ITER-relevant edge plasma conditions, during the ITER procurement phase, and targets its risk reduction.

In parallel, the contribution to the Broader Approach projects is shown to be complemented by an ambitious programme on integrated modeling of the main scenarios and an assessment of EC power needed for NTM stabilization.

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Session Classification: Overview Posters