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ITR/P1-10: Self-consistent Simulation of Plasma Scenarios for ITER Using a Combination of 1.5D Transport Codes and Free Boundary Equilibrium Codes

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Self-consistent transport simulation of ITER scenarios is an important tool for the exploration of the operational space and for scenario optimisation. It also provides an assessment of the compatibility of developed scenarios (which include fast transient events) with machine constraints, in particular with the poloidal field (PF) coil system, heating and current drive (H&CD), fuelling and particle and energy exhaust systems. Credible prediction of the plasma and plasmas systems behaviour can only be achieved when the best combination of high quality transport codes, using the most advanced theory-based transport models, are combined with state of the art free boundary equilibrium codes.

This paper summarises results of predictive modelling of all reference ITER scenarios with two EU suites of transport and free boundary codes. Modelling of 15MA baseline DT scenario with Q=10 and its variants was mostly based on GLF23 for the H-mode part of scenario, combined with the explicit modelling of edge barrier and type-I ELMs. The L-mode phase was simulated with Bohm/gyroBohm model. One of the novel elements was predictive modelling of fast transient phenomena, such as L-H and H-L transitions as well as predictive modelling of D and T densities and He ash accumulation. Self-consistent simulations of fast transients revealed potential difficulty for ITER PF position control system to maintain the plasma-inner wall distance during fast uncontrolled H-L transition, due to voltage saturation in the CS.

Since Hybrid and Steady State (SS) scenarios have less established theoretical and experimental basis, their predictive simulation rely more on ad-hoc assumptions about heat and particle transport inside the edge barrier. It was assumed that hybrid scenario has heat transport which ensures energy confinement time with H98y=1.3 during the flat top burn. The main emphasis of the simulation was on the selection of the heating and current drive scheme to ensure that qmin stays above 1 for at least 1000s. Also, the ability of ITER PF system to sustain fast transient phenomena (such as sudden loss of the internal transport barrier in SS scenario) as well as the control of MHD stability was studied.

Country or International Organization of Primary Author

United Kingdom

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Primary author: Mr PARAIL, Vassili (UK)

Co-authors: Dr LOARTE, Alberto, (ITER Organisation, France); Dr LABATE, Carmelo (CREATE/ENEA, Italy); Dr MCDONALD, Darren (Euratom/CCFE Fusion Association); Dr NARDON, Eric (CEA,IRFM, France); Dr KOECHL, Florian (Association EURATOM-ÖAW/ATI, Atominstitut, TU Wien, 1020 Vienna, Austria); Dr IMBEAUX, Frederic (CEA,IRFM, France); Dr SAIBENE, Gabriella (Fusion for Energy, Barcelona, Spain); Dr CORIGAN, Gerard (Euratom/CCFE Fusion Association); Mr URBAN, Jacub (CEA,IRFM,France); Dr ARTAUD, Jean-Francois (CEA, IRFM, France); Dr GARCIA, Jeronimo (CEA,IRFM,France); Dr LISTER, Jonathan (Association EURATOM-Confederation Suisse, CRPP, EFPL, Lausanne, Switzerland); Mr BESSEGHIR, Karim (Association EURATOM-Confederation Suisse, CRPP, EFPL, Switzerland); Dr GARZOTTI, Luca (Euratom/CCFE Fusion Association); Dr CAVINATO, Mario (Fusion for Energy, Barcelona, Spain); Dr MAGET, Patrick (CEA,IRFM,France); Dr ALBANESE, Rafaelle (CREATE/ENEA Italy); Dr SARTORI, Roberta (Fusion for Energy, Barcelona, Spain); AMBROSINO, Roberto (CREATE/ENEA Italy); Dr LITAUDON, Xavier (CEA,IRFM, Frabce); Dr GRIBOV, Yuri (ITER Organisation, France)

Presenter: Mr PARAIL, Vassili (UK)

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