

Introduction

8th IAEA DEMO Topic 1: Transient operational phases and transient loading environments for fusion DEMO power plants

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Scope of this session

This session aims to address what the transient operational phases as well as the transient behaviour of the plasma and the resulting time-varying loads add to the requirements for a DEMO fusion reactor, and how these issues are accommodated by the machine design.

Traditionally, fusion reactor designs are primarily determined from the point of view of the expected stationary performance at the operational point (burn phase). Specifically, the main design parameters minor and major radius, magnetic field, plasma density, safety factor and installed auxiliary power are chosen to serve the needs of achieving and maintaining the plasma under the predicted stationary conditions. Later on, while the design procedure proceeds and the main machine parameters are mostly defined, transient effects are being investigated more closely and additional requirements come up in order to avoid severe damage of components by the transient loads on top of the stationary ones. This approach can lead to expensive design changes e.g. by adding protection limiters, disruption mitigation systems or in-vessel control coils to fix the problems arising from the additional transient loads.

This session is meant to explore how some of the current reactor designs are addressing the problem of the transients, specifically for ITER, CFETR, EU DEMO and for a DEMO stellarator.

The first goal is to compile an “inventory” of the problems arising from transients, to assess their severity, and to present design solutions how to cope with them. A second aim could be to look in how far the problems with transients scale with reactor size, and whether the stellarator concept would really provide an advantage as compared to a tokamak. Finally, one may discuss whether an earlier treatment of the transient issues could shift the machine concept into a different parameter range, rather than adding expensive components to the already existing design.

Program

- Plasma transient challenges (disruptions, detachment loss, equilibrium) and resulting requirements for the machine design of a DEMO tokamak reactor
Speaker: Francesco Maviglia (EUROfusion)
- Development of plasma control for the transient phases of a DEMO tokamak discharge
Speaker: Emiliano Fable (IPP Garching, Germany)
- Strategies for gradual increase of flat-top plasma performance towards the operational point according to the ITER operational plan
Speaker: Wolfgang Treutterer (IPP Garching, Germany)
- Solutions for the transients and load variations of the CFETR operation scenarios
Speaker: Ge Zhuang (USTC, China)
- Current status of helical fusion reactor design and study on operation control scenario
Speaker: Takuya Goto (NFIS, Japan)