8th DEMO workshop

Tuesday, 30 August 2022 - Friday, 2 September 2022

Vienna, Austria

Scientific Programme

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

Chairs: Wolfgang Biel and Francesco Maviglia (EU-Germany)
External chair: Nobuyuki Aiba (Japan)

Scope of the 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.

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)

Topic 2: ITER TBM program status, DEMO needs and satellite facilities needed

Chair: Charles Kessel (USA)
External chair: Seungyon Cho (South Korea)

Scope of the session:
1. Review of ITER TBM program technical targets and progress

2. Preparation for DEMO and other next steps, what are required extensions to ITER TBM achievements
3. Introduction to multiple DEMO – level characteristics (n-flux, n-fluence, materials, temperatures, ancillary systems, ….)

4. CN, KO, EU, JP, UK, RF, US facility development/plans to support next-step devices and DEMO blanket (fuel cycle, material test, remote handling, cooling technology development, breeder technology, high heat flux, etc.)

Review of ITER TBM program technical targets and progress

Speaker: Luciano Giancarli (ITER)

Preparation for DEMO and other next steps, what are required extensions to ITER TBM achievements

Speaker: Charles Kessel (ORNL, USA)

ITER TBM facilities, next-step devices, and DEMO-focused facilities for the blanket

KO facilities anticipated for DEMO preparation
Speaker: Seungyon Cho (KFE, South Korea)

JP facilities anticipated for DEMO preparation
Speaker: Tanigawa Hiroyasu (QST, Japan)

EU facilities anticipated for DEMO preparation
Speaker: Lorenzo Boccaccini (KIT, Germany)

CN facilities anticipated for DEMO preparation
Speaker: Xuru Duan (SWIP, China)

US facilities anticipated for DEMO preparation
Speaker: Charles Kessel (ORNL, USA)

RF facilities anticipated for DEMO preparation
Speaker: Mikhail Shlenskii (Kurchatov Institute, Russia)

UK facilities anticipated for DEMO preparation
Speaker: Mike Gorley (UKAEA, UK)

Topic 3: Efficiency: coolant selection, cost, and delivering time

Chairs: Michael Gorley (UK) and Klaus Hesch (EU-Germany)
External chair: Robert Stieglitz (EU-Germany)

Scope of the session:
The core topic of the session to be addressed is the integrated, lifecycle view of efficacy within DEMO reactors. We want to elucidate what are the key drivers for power to the grid, where should efficiency be driving design for DEMO reactors.
We should review if there are areas/technologies we should be pursuing to have substantial gains or where the TRL and timeframes for development are an issue. How much uncertainty and margin do we anticipate in DEMO reactors? Can this be accommodated by the reactor systems and electrical grid connections or do we have major issues?
We aim to leave this topic session with attendees understanding the key drivers in power output from fusion reactors, the dependencies and uncertainties of these systems, and what should be looked at in DEMO programs and to maximize fusion energy output from our reactors.

Plasma physics performance and impact on plant efficiency

Speaker: Yutaka Kamada and Sakamoto Yoshiteru (JT-60SA, Japan)

Thermal power management in view of coolant choice and the balance of plant

Speaker: Wolfgang Hering (KIT, Germany) and Luciana Barucca (Ansaldo, Italy)

Electrical power management: the path toward energy production

Speaker: Elena Gaio (CNR, Italy)

Nuclear power plant digital twinning for efficient operation

Speaker: Qing Li (CNNC, China)

Fusion plant flight simulator: present status

Speaker: Jaemin Kwon (KFE, South Korea) and Emiliano Fable (IPP, Germany)

Special topics

Materials database and needed facilities (focus on structural materials like RAFM)

Speaker: Eberhard Diegele (Germany)

Overview of broader approach phase II programme

Speaker: Susana Clement Lorenzo (F4E, EU)