



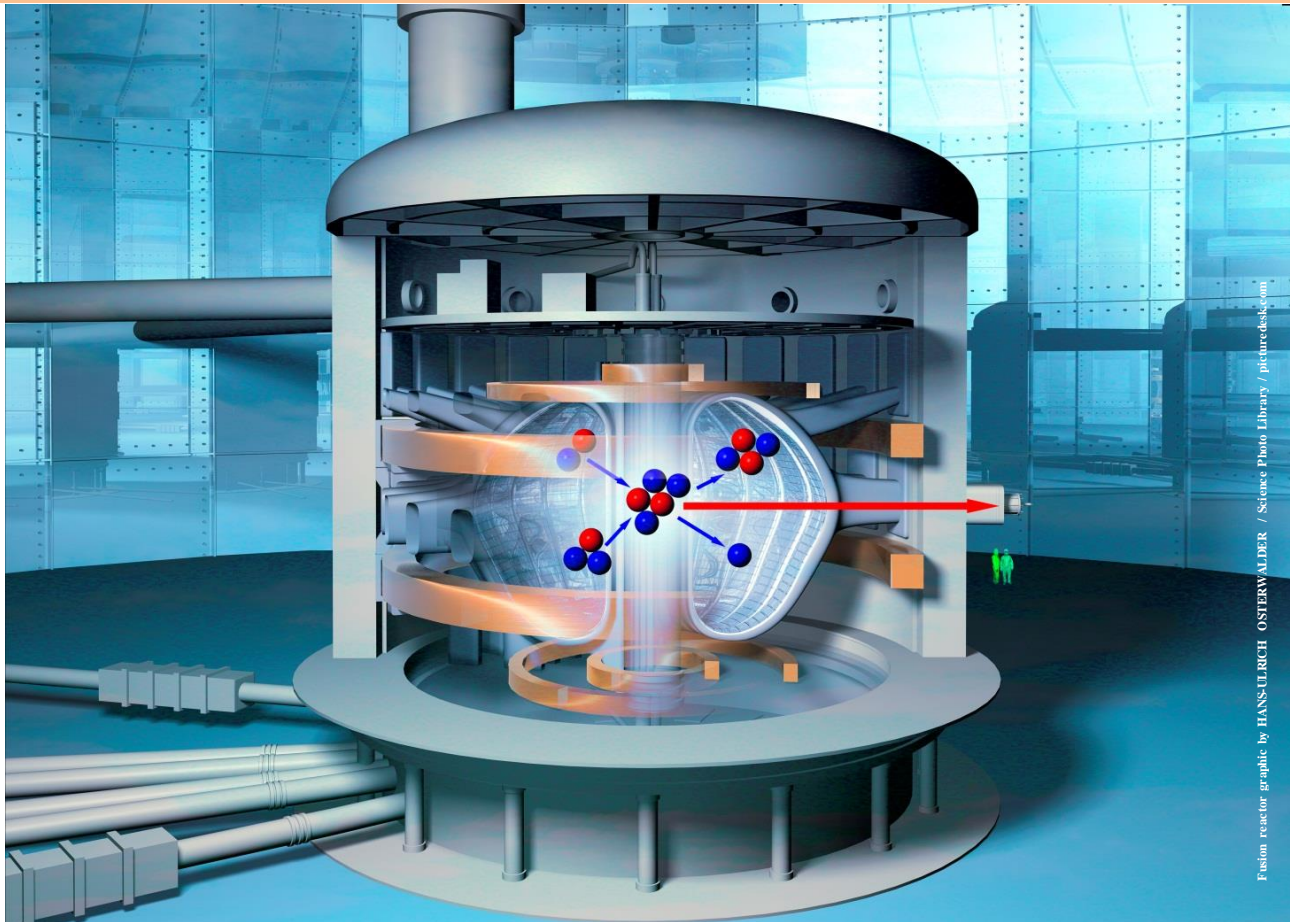
IAEA

International Atomic Energy Agency

Atoms for Peace and Development

Programme

EIGHTH IAEA DEMO PROGRAMME WORKSHOP



Fusion reactor graphic by HANS-ULRICH OSTERWALDER / Science Photo Library / picturedisc.com

30 August – 2 September 2022

Vienna International Centre

Vienna, Austria

Tuesday, 30 August 2022

10.00-10.25	Opening remarks and workshop introduction M. Chudakov, Deputy Director General, Nuclear Energy, IAEA S. M Gonzalez de Vicente and L. Di Pace, Scientific Secretaries, IAEA M. Xu, 8th DEMO Programme Workshop Chair, SWIP
Topic 1	Transient operational phases and transient loading environments for fusion DEMO power plants <u>Chairs: Wolfgang Biel, Francesco Maviglia, and Nobuyuki Aiba</u>
10.25-10:35	FRANCESCO MAVIGLIA AND NOBUYUKI AIBA <i>Introduction and overview</i>
10.35-11:20	FRANCESCO MAVIGLIA <i>Plasma transient challenges and resulting requirements for the machine design of a DEMO tokamak reactor</i>
11.20-11.35	Coffee/Tea Break
11.35-12.20	EMILIANO FABLE <i>Development of plasma control for the transient phases of a DEMO tokamak discharge</i>
12.20-13.05	WOLFGANG TREUTTERER <i>Strategies for gradual increase of flat-top plasma performance towards the operational point according to the ITER operational plan</i>
13.05-14.05	Lunch Break
14.05-14.50	GE ZHUANG <i>Solutions for the transients and load variations of the CFETR operation scenarios</i>
14.50-15.35	TAKUYA GOTO <i>Current status of helical fusion reactor design and study on operation control scenario</i>
15.35-15.50	Coffee/Tea Break
15.50-16.50	Discussion
Special Topic 2	
16.50-17.35	SUSANA CLEMENT LORENZO <i>Overview of broader approach phase II programme</i>
17.35	Adjourn

Wednesday, 31 August 2022

Topic 2	ITER TBM program status, DEMO needs and satellite facilities needed Chairs: Charles Kessel and Seungyon Cho
10.00-10.10	SEUNGYON CHO <i>Introduction and overview</i>
10.10-10.50	LUCIANO GIANCARLI <i>Review of ITER TBM program technical targets and progress</i>
10.50-11.05	Coffee/Tea Break
11.05-11.25	SEUNGYON CHO <i>KO facilities anticipated for DEMO preparation</i>
11.25-11.45	TANIGAWA HIROYASU <i>JP facilities anticipated for DEMO preparation</i>
11.45-12.05	LORENZO BOCCACCINI <i>EU facilities anticipated for DEMO preparation</i>
12.05-13.05	Lunch Break
13.05-13.11	ANKIT GANDHI POSTER: <i>Numerical analysis for optimization of circulation power in first wall of Indian helium cooled solid breeder blanket using He-CO₂ gas mixture</i>
13.11-13.17	DMITRY TARENTYEV POSTER: <i>Qualification of EUROFER97 for TBM: contribution of the EUROfusion project within 2021-2025</i>
13.17-13.23	INESH KENZHINA POSTER: <i>Reactor studies of two-phase lithium ceramics in Kazakhstan</i>
13.23-13.29	ANGEL IBARRA POSTER: <i>Capabilities and status of the IFMIF-DONES project</i>
13.29-13.35	IVAN FERNANDEZ-BERCERUELO POSTER: <i>An approach for the pathway towards the development of high performance breeding blankets</i>
13.35-13.41	SIMONA BREIDOKAITE POSTER: <i>Overview of the R&D of materials intended for DEMO and DONES at Lithuanian Energy Institute</i>
13.41-13.47	P.N. MAYA POSTER: <i>Exploration of a compact DEMO reactor: constraints on shielding materials and HTS magnets from parameter-space scans</i>
13.47-13.53	SOMSAK DANGTIP POSTER: <i>CPAF linear device for plasma materials exposure experiments</i>

13.53-14.13	XURU DUAN <i>CN facilities anticipated for DEMO preparation</i>
14.13-14.33	CHARLES KESSEL <i>US facilities anticipated for DEMO preparation</i>
14.33-14.53	MIKHAIL SHLENSKII <i>RF facilities anticipated for DEMO preparation</i>
14.53-15.13	MIKE GORLEY <i>UK facilities anticipated for DEMO preparation</i>
15.13-15.53	CHARLES KESSEL <i>Preparation for DEMO and other next steps, what are required extensions to ITER TBM achievements</i>
15:53-16:10	Coffee/Tea Break
16:10-17:10	Discussion
Special Topic 1	
17:10-17:55	EBERHARD DIEGELE <i>Materials database and needed facilities (focus on structural materials like RAFM)</i>
17.55	Adjourn

Thursday, 1 September 2022

Topic 3	Efficiency: coolant selection, cost, and delivering time Chairs: Michael Gorley, Klaus Hesch, and Robert Stieglitz
10.00-10.10	MICHAEL GORLEY AND KLAUS HESCH <i>Introduction and overview</i>
10.10-10.55	YUTAKA KAMADA AND SAKAMOTO YOSHITERU <i>Plasma physics performance and impact on plant efficiency</i>
10.55-11.40	WOLFGANG HERING AND LUCIANA BARUCCA <i>Thermal power management in view of coolant choice and the balance of plant</i>
11.40-11.55	Coffee/Tea Break
11.55-12.40	ELENA GAIO <i>Electrical power management - the path toward energy production</i>
12.40-13.40	Lunch Break
13.40-13.46	SERGEY ANANYEV POSTER: Progress in modeling the D/T component flows in fueling system of controlled fusion reactor by SOLPS+ASTRA+FC+FNS codes
13.46-13.52	STEVEN WRAY POSTER: Power balance challenge for fusion
13.52-14.37	QING LI <i>Nuclear power plant digital twinning for efficient operation</i>
14.37-15.22	JAE-MIN KWON AND EMILIANO FABLE <i>Fusion plant flight simulator - present status</i>
15.22-16.22	Discussion
Topic summaries	
16.22-16.42	FRANCESCO MAVIGLIA <i>Topic 1 Summary</i>
16.42-17.02	SEUNGYON CHO <i>Topic 2 Summary</i>
17.02-17.22	MICHAEL GORLEY AND KLAUS HESCH <i>Topic 3 Summary</i>
17.22-17.42	Discussion
17.42-18.22	M. XU AND S. M. GONZALEZ DE VICENTE <i>Workshop final remarks and closing speech</i>
18.22	Adjourn

Friday, 2 September 2022

Closed session

10.00-10.30	ALL <i>Identification of key elements</i>
10.30-12.00	ALL <i>Preparation of the summary paper</i>
12.00-13.00	ALL <i>Preparation of next edition</i>
13.00	End of Meeting

List of Posters/Short Presentations

Author & Title
ANANYEV S.S. P1 – Progress in modelling the D/T component flows in fueling system of controlled fusion reactor by SOLPS+ASTRA+FC+FNS codes
BREIDOKAITE S. P3 – Overview of the R&D of materials intended for DEMO and DONES at Lithuanian Energy Institute
DANGTIP S. P4 – CPAF linear device for plasma materials exposure experiments
FERNANDEZ-BERCERUELO I. P2 – An approach for the pathway towards the development of high performance breeding blankets
GANDHI A. P5 – Numerical analysis for optimization of circulation power in first wall of Indian helium cooled solid breeder blanket using He-CO₂ gas mixture
IBARRA A. P6 – Capabilities and status of the IFMIF-DONES project
KENZHINA I.E. P7 – Reactor studies of two-phase lithium ceramics in Kazakhstan
MAYA P.N. P8 – Exploration of a compact DEMO reactor: constraints on shielding materials and HTS magnets from parameter-space scans
TERENTYEV D. P9 – Qualification of EUROFER97 for TBM: contribution of the EUROfusion project within 2021-2025
WRAY S. P10 – Power balance challenge for fusion

TOPICS

1. TRANSIENT OPERATIONAL PHASES AND TRANSIENT LOADING ENVIRONMENTS FOR FUSION DEMO POWER PLANTS

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.

Topic Chairs: *Wolfgang Biel, Germany, and Nobuyuki Aiba, Japan*

2. ITER TBM STATUS, DEMO NEEDS AND SATELLITE FACILITIES NEEDED

The Topic is split into three parts:

1. Review of ITER TBM technical targets and progress
2. Preparation for DEMO and other next steps, what are required extensions to ITER TBM achievements, and introduction to multiple DEMO – level characteristics (n-flux, n-fluence, materials, temperatures, ancillary systems,)
3. KO, JP, EU, CN, US, RF, and UK 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.)

Topic Chairs: *Charles Kessel, USA, and Seungyon Cho, Korea*

TOPICS

3. EFFICIENCY: COOLANT SELECTION, COST AND DELIVERING TIME

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 and where should efficiency drive the design of 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 reactors 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 investigated in DEMO programmes to maximize fusion energy output from our reactors.

Topic Chairs: *Michael Gorley, UK, Robert Stieglitz, Germany, and Klaus Hesch, Germany*

4. SPECIAL TOPICS

- Materials database and needed facilities (focus on structural materials like RAFM)
Eberhard Diegele, Germany
- Overview of Broader Approach Phase II Programme
Susana Clement Lorenzo, EU