IFERC Newsletter

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International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Meeting

23rd IFERC Project Committee (IFERC PC-23) meeting

1. General

The 23rd International Fusion Energy Research Centre (IFERC) Project Committee (IFERC PC-23) meeting was held at Rokkasho on 9th-10th October, 2018, followed by the HPC Workshop on 11th October. Twenty-six participants attended the IFERC PC-23 in person or via videoconference (VC). Among these were 6 committee members, including the PC chair, David Maisonnier, 6 project team members, including the Project Leader, Noriyoshi Nakajima, one secretary, 2 PC invited experts including the Peer review chair, Maurizio Gasparotto, and 11 experts from the EU and JA Implementing Agencies.

IFERC project proceeds as originally planned except for minor delay of reports. The recent status of DEMO Design Activity (DDA), of DEMO R&D Activity: Analysis of JET tile and dust, and of REC Activity was reported together with information from IFERC-HPC follow-up working group. In parallel, Work programme 2019 was proposed by PL, and PC members recommended this document to Broader Approach (BA) Steering Committee (SC) in the upcoming 23rd BA SC meeting to be held in Grenoble on 4th–5th December, 2018 for approval.

The most important issue in this meeting was to draft IFERC Project Plan in BA Phase II from April 2020 to March 2025, in accordance with the requirement by BA SC in the last BA SC-22 and taking into account the recommendations of the 2nd peer review for DMEO R&D. For such a purpose, the final report of the peer review for DMEO R&D was submitted before PC-23 in advance and also presented in PC-23. The assessment of the peer review members was that all the activities until May 2017 were fully in line with the expected results and covered the missions agreed, and the peer review members recommended the implementation of the proposed plans both until March 2020 and in BA Phase II. The draft IFERC Project Plan in BA Phase II reflecting the recommendations by the peer review panel was recommended by the IFERC PC members to BA SC in the upcoming 24th BA SC meeting for consideration.

2. DEMO Design Activity

Regarding DDA, the activities continued to investigate key issues, which will impact the selection of main machine parameters and technical specifications for pre-conceptual designs of DEMO. The progress was seen in the following 9 areas: 1) system code; the cost model implemented in the JA systems code TPC was assessed with the support of industry. Uncertainty analysis including cost estimation with the JA systems code started to cooperate with EU's systems code study. 2) DEMO physics basis; integration and optimization of plasma scenario modelling have been carried out in JA and EU. MHD stability analysis of high beta JA DEMO plasma, using MARG2D (2D linear stability analysis code), showed that the conducting wall needs to be located closer to the core plasma to attain β_N ~3.4 assumed in JA Model 2014. Both EU and JA have been recognized plasma control to mitigate/ suppress ELM activities. 3) Divertor and power exhaust; DEMO divertor operation in relatively low SOL density (n_e^{sep} = 2-3x10^{19}m^{-3}), which is expected both in JA and EU DEMOs, has been investigated by SONIC simulation code. Baseline radiative scenario for the large power exhaust concept (JA) with exhausted power to the code-edge (P_{out}) of 250MW and the radiation fraction (f_{rad}) of 80% has solutions to satisfy the conditions such as the peak heat load of smaller than 10 MW/m^2, impurity density concentration at SOL (n_{Ar}/n_e) of smaller than 1% and relatively lower target T_e (such as 20 eV) at the attached plasma region. EU studied that transient divertor heat

loads in fully attached divertor are prohibitive, and detached divertor (at least at the strike-point) is necessary. 4) In-vessel components and breeding blanket; for the EU DEMO breeding blanket, the focus from now is on the two most promising blanket concepts. i.e., the HCPB and the WCLL. The JA blanket module concept was updated to withstand the over-pressurization due to an in-box LOCA. 5) Remote maintenance; for the EU DEMO, a proof of principle review of the blanket transporter took place in early 2018. the kinematics and control requirements generated by payload flight paths and characteristics are very challenging. 6) Superconducting magnet; for JA DEMO, 3-D electromagnetic field and structural analysis for mechanical and supporting structures on TF coils were carried out with ANSYS. The analysis results showed that the displacement of TF coils with supporting structure considering NBI ports was within a design criterion. 7) Balance of plant (BoP); in the EU DEMO, work is ongoing, for both options of helium and water as coolants of the breeding blanket to finalize the design of Primary Heat Transfer Systems (PHTSs), Intermediate Heat Transfer System (IHTS) and Power Conversion System (PCS) (plant option with Energy Storage System), to verify/demonstrate its feasibility by a pulsed DEMO, and to assess the readiness of the technologies postulated. In the JA DEMO, a concept of PHTS (water) and a heat removal system for in-vessel components were developed, in which coolant bypass system and larger pipe diameter were applied to enable a simplified 2-loop configuration of PHTS. 8) Structural material R&D; the material property handbook (MPH), after two releases on EUROFER97, was extended in EU by draft chapters on the baseline materials CuCrZr and tungsten as well as functional materials. In addition to the campaigns underway to fill first gaps in the database for baseline materials, three new irradiation campaigns were launched for down-selection of "advanced high heat flux materials" (Cu and W based alloys, 5 options and 3 temperatures, each, between 150-1100°C) and 20 functional materials for diagnostics and windows. The MPH activities were also continued in JA toward a common DEMO MPH. A database of fatigue, creep and creep-fatigue properties of reduced activation ferritic/martensitic steel F82H was under review. Preparation of tungsten MPH was initiated. 9) Breeding functional materials R&D Design; As advanced neutron multipliers, fabrication methods for beryllides pebbles of $Be_{12}V$ with the diameter of 1mm have been successfully developed in JA by combining plasma sintering and rotating electrode granulation. From the trial granulation experiments of the prototype $Be_{12}V$ pebbles, single-phase $Be_{12}V$ pebbles were directly fabricated in the granulation yield of 70 % via the rotating electrode granulation method using plasma-sintered beryllide electrode.

3. DEMO R&D Activity

As for DEMO R&D, in 2018 the work in the joint PA for analysis of JET dust and tiles concentrated on:

- conclusive review of the data obtained in the period June 2017 – May 2018, including a research visit of the EU Team to IFERC followed by several meetings with JA QST & Universities researchers to prepare results for presentation at the PSI-23 conference (June 2018),
- continuation of the analysis of new specimens (bulk Be limiter tiles), which were received at IFERC from JET in the last winter,
- starting the analysis of a new set of sample materials, such as, (1) Be first wall tile (ILW-1), (2) W-Lamellae divertor tile (ILW-1), (3) divertor tile of W-coated CFC (JET-ILW 3rd campaign: ILW-3), and (4) Dust (ILW-3), which have been transported from JET to IFERC in the summer of 2018, divided in two packages,
- publications and presentations at conferences in 2018 (see list of publications);

Results of tritium (T) evaluation in dust sample were recently summarized. A "Combustion method" of small amount dust (a few mg) in Sn-film was newly developed for a tritium measurement in dust particles. Most T inside dust particles is collected in bubblers. T-retention on dust surface was evaluated by Imaging Plate (IP), and the variation on the particles was determined by material composition (EPMA) and micro-structure (SEM) analysis. These results suggest that a large amount of carbon (C) dust remained (for instance inside divertor structure), and that most of tritium was retained in C-dominated dusts, and partly in Be-dominated dust. A similar analysis of new samples (ILW-3) will reveal the retention characteristics under the metal PFC conditions with increasing heat loading in ILW-3 plasma operation.

4. ITER Remote Experimentation Centre (REC)

Concerning REC, after completing preparation of remote facility, the development of remote participation tools, and various verification tests in 2017, the massive data transmission tests with LHD in NIFS via L2VPN, and data transmission tests with JET via L3 Layer were executed. Also, the preparation of demonstration of remote participation in WEST experiment in Cadarache from REC at Rokkasho continued, and the demonstration is planned in the late November.

5. CSC and IFERC HPC follow-up working group

The main results of "IFERC HPC follow-up working group" activities are to have obtained better understanding of the situation and plans for HPC centres for fusion in Europe and in Japan, to have finalized the procurement arrangement for providing the computer time for joint simulation projects, and to have confirmed a possible timeframe for the introduction of a joint supercomputer in the context of BA Phase II based on the expected lifetime of the current systems in EU and in JA.

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