IFERC Newsletter

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Meeting

19th IFERC Project Committee (IFERC PC-19) meeting

1. General

The 19th International Fusion Energy Research Centre (IFERC) Project Committee (IFERC PC-19) meeting was held at Rokkasho on 28th - 29th September, in conjunction with the 3rd DEMO Review Meeting. Twenty nine participants attended the IFERC PC-19 in person or via videoconference (VC). Among these were 5 committee members, including the PC chair, David Maisonnier, 8 project team members, including the Project Leader, Noriyoshi Nakajima, one secretary, 1 JA invited expert, 12 experts from the EU and JA Implementing Agencies (4 EU experts via VC).

2. DEMO Design Activities (DDA)

The DEMO Design Activities (DDA) work of the Phase 2C: Pre-conceptual design phase, started in January 2015. In the first half of 2016, DDA Integrated Project Team continued to investigate key issues, which will impact the selection of main machine parameters and technical specifications for pre-conceptual design of DEMO. The activities in Phase 2C emphasize (i) integration of component design and R&D for DEMO pre-conceptual design, and (ii) further work on critical design issues that were identified to be resolved in the 2015 Intermediate Report. In addition, the process to prepare the 2nd Intermediate Report of DDA (9 topics, including safety study) started. Common topics of DEMO Design for both IAs in 2016 are (1) plasma design and operation scenario, (2) in-vessel component design for plasma vertical stability, performance and TBR (Tritium Breeding Ratio), (3) heat load analysis on the first wall and impact on the blanket design, (4) power exhaust, divertor study and technology development, (5) remote maintenance, (6) superconducting magnets, (7) plant system and Balance-of-Plant, and (8) structural material database. As for (1) plasma design and operation scenario, scoping studies of pulse and steady-state operations were carried out in JA and EU (DEMO1) using system codes, while DEMO concepts are designed for steady-state and pulse operation, respectively. JA scoping study demonstrated flexible operation from a few hours to steady-state in the same device configuration. In Europe, main issues for the steady-state design of DEMO2 were discussed and compared with assumptions on physics and technology development in DEMO1. Concerning (2) in-vessel component design for plasma vertical stability, performance and TBR, an increment of the plasma elongation is a requirement for higher performance. The design of the vacuum vessel, breeding blanket and conducting shell, and their impacts on vertical stability have been investigated. JA reported higher elongation design needs reduction in breeding blanket thickness while satisfying a minimum level of TBR. A comparison of single null and double null divertors is ongoing by EU for some design parameters of elongation and triangularity. As to (3) heat load analysis on the first wall and impact on the blanket design, plasma and fast particle loads have been studied in order to improve the first wall design, in addition to the radiation and CX power loads. Regarding (4) power exhaust, divertor study and technology development, power handling and divertor with impurity seeding have been investigated with simulation and experiments, and requirements of the plasma and divertor design were shown. Development of plasma facing and heat sink materials was reported. As for (5) remote maintenance, development of a vertical remote maintenance scenario for blanket segments is a high priority issue for EU and JA. Servicing of pipe connections is a common issue being addressed in R&D. As to (6) superconducting magnets, the feasibility of cable-in-conduit type conductor winding on the radial plate was assessed, in addition to 3 options for TF conductor winding in JA. TF magnet design (3 winding pack options) was tested and showed improved performance in EU. Regarding (7) plant system and Balance-of-Plant, pumping power for the water/gas cooling in DEMO power plant was discussed as a major concern of the plant design. Finally, as to (8) structural material database, in EU, the 1st release of the EUROfusion MPH (Material Property Handbook) as well as a "Set of rules and methodologies for elastic design of divertor components" were rolled out. In JA, extensive work on database assessment of physical properties is continued. On the other hand, safety and environment research has been continued in the JA-HT with the support of a European expert, for a water-cooled DEMO with a fusion power of 1.5 GW and average neutron wall load of 1 MW/m^2. The purpose of the research is to understand distinctive safety characteristics of DEMO and to develop reasonable accident prevention and mitigation systems so as to assure safety. Progress was made in two areas: (i) analyses of hypothetical accidents and (ii) management strategy of radioactive materials.

3. DEMO R&D

Based on the common interest of both IAs towards DEMO, DEMO R&D activities have been carried out successfully in accordance with the original and amended Work Programme 2016 and PAs, for the continued 5 task areas for DEMO blanket: T1) SiC_f/SiC composites, T2) tritium technology, T3) materials engineering, T4) advanced neutron multiplier, and T5) advanced tritium breeders. As to EU/JA joint collaboration included in T2, analysis of dust and tiles of JET-ILW continues. In the first half of 2016, work has been concentrated in evaluation and discussion of results obtained in October 2015, identification of gaps and definition of additional studies, definition of additional necessary studies performed by surface analysis methods for dust and divertor samples, preparation of material for presentation at conferences in 2016 and planning of future activities for the fall of 2016. After completion of RI licensing of XPS for analysis of JET tile and dust, analysis of ILW sample in 2015 was continued from January 2016. Observation of tile and dust, analysis of their microstructure and their composition, started with the use of Transmission Electron Microscope (TEM) and Electron Probe Micro Analyzer (EPMA). Evaluation of hydrogen isotope inventory with Thermal Desorption Spectroscopy (TDS) and Liquid Scintillation Counter (LSC) was also implemented in January 2016. It was found that the retained tritium amount was not uniform even on a tile, and the largest amount was observed near the inboard-side pumping slot. A series analysis of ILW sample started on 13 June 2016. As for T3, Reduced activation ferritic/martensitic (RAFM) steel F82H (Fe-8Cr-2W, V, Ta) has successfully demonstrated its stable characteristics, regardless to the product size, even with the real scale production technology. Regarding T4, to prevent increase of H_2 generation associated with increase of the specific surface area, various beryllides have been surveyed. As a result, $Be_{12}V$ composition was selected, because of 1) no peritectic reaction and 2) similar nuclear properties to Be-Ti beryllide. $Be_{12}V$ single phase pebbles were successfully fabricated directly by the REM, and demonstrated a lower reactivity with water vapor. As for T5, pebbles of super advanced tritium breeder LTZO20; $Li_{2+x}TiO_{3+y}$ with 20 wt.% Li_2ZrO_3 were developed by emulsion method and showed not only high stability but also high Li density.. LTZO20 pebbles were easily sintered under air, and exhibit good tritium release properties. In particular, the released amount of HT gas is greater than that of HTO water vapor. As to T1, a compatibility test (corrosion test) of CVD SiC with liquid Pb-Li by using equipment developed in ENEA showed that the reactive layer thickness saturated with increasing exposure time, namely, good compatibility.

4. Computational Simulation Centre (CSC)

The CSC activity was performed by the IAs in coordination with the Standing Committee (StC) regarding allocation of computer resources to selected projects. So far, the CSC activity has progressed in full accordance with the project plan and with the schedule of various PAs. The official opening of the last extension to Helios, based on Nvidia GPGPU was on 1 February 2016. The Integrated Project Team of CSC including the HPC team continuously and dedicatedly supports users and stably operates Helios with a high availability ratio and a high utilization rate, leading to the fact that 587 peer-reviewed papers (accumulated number) are accepted or published in scientific journals like Physics of Plasmas (111 papers) and Nuclear Fusion (92 papers) and also Physical Review Letters (15 papers) as of September 2016.

5. Remote Experimentation Centre (REC)

Environmental preparation of the REC room and REC network are well ongoing, and in parallel, some verification tests have been done based on the agreed table of the verification tests. The data transfer tests have been performed between EU institutions (RFX in Padova) and the REC in April 2016. The functions of remote data access and remote computer access were examined, including the visualization of the experiment data in the REC, by the application of MDSplus/UDT. All tests had good results, smooth data access was obtained and usefulness of the visualization program was verified. The fast data transfer test with ITER was performed in collaboration with the National Institute of Informatics (NII) and the National Institute for Fusion Science (NIFS) from 30th August to 5th September. High-speed transfer of 1TB of experiment data in 30 minutes, which is assumed in the initial experiments of ITER, was demonstrated repeatedly by using the software called "mmcftp" (Massively Multi-Connection File Transfer Protocol) developed in NII. In total, 50TB data were sent from ITER to REC in a day. This is the world largest inter-continental high speed data transfer per day. This result was released through press and ITER newsletter.

(IFERC Project Leader: Noriyoshi Nakajima)