IFERC Newsletter

IFERC

IFERC-N-2014-1, 3 April 2014
International Fusion Energy Research Centre, Rokkasho, Aomori 039-3212, Japan

Meetings

5th Technical Coordination Meeting of DEMO Design Activities

The 5th Technical Coordination Meeting (TCM-5) of DEMO Design Activity (DDA) was held at Katsura campus, Kyoto University in Kyoto, Japan on 4-5 February 2014 with 54 participants (including 25 remote participants); 4 from IFERC-PT, 26 from JA home team and 24 from EU home team. In this meeting, the following topics were covered: 1) code development for plasma simulation, 2) design criteria, 3) magnets, 4) divertor, 5) system codes, 6) blanket, 7) tritium system, 8) remote maintenance, 9) safety and 10) support toward DEMO by Japanese industry.

The DDA TCM-5 showed clearly that there has been good progress made on a number of critical areas, in particular: a) fusion reactor system codes, b) work on divertor power exhaust both for the part (i) related to DEMO relevant divertor edge modeling simulations for highly-radiative divertor (ITER-like geometries) and (ii) on advanced magnetic divertor configurations (i.e., SXD and snowflake; c) DEMO remote maintenance studies.

Since it was confirmed that the benchmark of TF coil engineering in both system codes (PROCESS and TPC-SCONE) produced similar results, it was agreed to conduct scoping studies to evaluate the impact of more refined plasma elongation, bootstrap current and cost models as a next step. Attempt to improve bootstrap current model and superconducting model is on-going. Using the codes, a scoping study of DEMO machine main parameters was started to explore within a wide range of options (major radius of ~6-13 m) and electric net power (0.2-0.5 GW), the best design configurations, always keeping the heat flux limit to the divertor at a level deemed to be attainable with realistic advancement of existing technologies.

The divertor simulation study has been continued to pursue fully detached plasma in the conventional divertor geometry. As an alternative divertor option, there is some progress on the study of advanced divertor configurations, Short Super-X Divertor (Short-SXD) was proposed and modelling for divertor simulation is in progress to estimate the power loads. An engineering study is also being done to analyze integration of a Short-SXD cassette. An arrangement of poloidal field coils (PFC) and the currents required to configure the Short–SXD were investigated, suggesting that installation of a few interlink superconducting coils is necessary near the divertor between the vacuum vessel and TF coils. A design study of interlink winding was carried out regarding 1) in-situ winding of the interlink coils, 2) in-situ impregnation of insulator, and 3) possible superconducting materials, indicating that the conductor needs to have high current properties such as Nb_3Al and high-temperature superconductor. Work on the incremental approach to divertor and power exhaust modelling has continued with more detailed comparisons of SOLPS to L-mode experiments on JET and ASDEX Upgrade. Further experiments at high power and large radiated fractions have been conducted, and will continue at JET to assess the mechanism limiting the radiation.

As one of the Remote Maintenance (RM) studies, efforts has been concentrated on the MMS (Multi-Module Segment) RM scheme and the elaborated concept of the transport mechanism of MMS in the vacuum vessel, service connections, transportation of used MMS in the corridor, etc. have been studied. On the other hand, various RM schemes focusing on TFC size and MHD plasma equilibrium were assessed, and it was confirmed that MMS-like RM scheme using vertical maintenance ports has advantages in the TFC size and the required current of poloidal field coils. In conjunction with RM, the definition of waste management scenario and the design study of the hot cell and waste storage are in progress.

Since April 2013, the safety study has been mainly concentrated on 1) formulation of safety analysis data list (SADL), 2) dose analysis on environmental release of tritium, and 3) analysis of hypothetical severe accidents. Key plant data were assessed including the primary coolant system, the vacuum vessel volume and pressure capacity, the volume of the final confinement barrier, and the pressure suppression system. Furthermore, detailed neutronic data such as decay heat and radioactivity of in-vessel components were calculated. The dose analysis was carried out to estimate the environmental release of tritium in an accident to the early public dose. The systematic analysis was done for various conditions using ACUTRI and UFOTRI codes. Also, accidental sequence analysis by MELCOR-fus has been devoted to hypothetical severe accidents for a water-cooled DEMO.

(Haruhiko Takase)

Group Photo at Katsura Campus, Kyoto University

Cake in celebration of DDA-TCM-5