IFERC Newsletter

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Meetings

3rd Joint Technical Coordination Meeting between DDA and R&D

The 3rd Joint Technical Coordination Meeting (JTCM-3) of DEMO Design Activity (DDA) and DEMO R&D activity was held at Fusion for Energy in Barcelona Spain on 26 September 2014 with 42 participants (including remote participants); 6 from IFERC Project Team (IFERC-PT), 15 from JA home team and 21 from EU home team. The objective of this meeting was to enhance mutual cooperation between DEMO R&D and DDA following the request by the peer review panel of DEMO R&D activity implemented in 2012.

In the meeting, the latest results (period from January to September 2014) and future plans of DDA and R&D activity were reported by each Project Manager (PM) of JA and EU.

The results of DDA by JA were reported as follows: BA DEMO design has been carried out as either joint or independent work by JA and EU in different areas of DEMO design in an efficient manner as to gain a better comprehension of DEMO. The knowledge learned from the DDA suggests that a potential DEMO will be relatively large (Plasma major radius > ~8 m) and low power (≤ 1.5-2 GW). Safety guidelines to be obtained throughout the on-going safety research need to be consolidated for the DEMO concept in order to achieve high-integrity system design.

The results of DDA in the EU were reported as follows: The demonstration of electricity production before 2050 in a DEMO Fusion Reactor that produces its own fuel is the primary objective of EU program. ITER is an indispensable step and advances obtained (technology/ physics) will be an input for DEMO. However, there are still outstanding challenges and large gaps beyond ITER where R&D and design work is urgently needed. The emphasis is on a pulsed “low extrapolation” near-term DEMO that could be delivered in the short to medium term. An integrated SE&DI (Systems Engineering and Design Integration) oriented approach is essential from the early concept design stage: (i) to better understand the problems and evaluate the impact of uncertainties and technical risks of foreseeable technical solutions; (ii) to identify design trade-offs and constraints; and (iii) to prioritize the R&D needs. Ensuring that R&D is focused on resolving uncertainties in a timely manner and that learning from R&D is used to responsively adapt the technology strategy will be crucial to the success of the DEMO. The involvement of industry from the early stage is desirable.

The results of R&D activity by JA were reported as follows: At the beginning of the BA activities, a series of discussions took place between EU and JA, and five major tasks were agreed upon: structural materials (SiC and RAFM), tritium technology, and three tasks related to blanket materials (steels, Li and Be). Plans and schedules for the five tasks were carried out in accordance with PA documents: 2008 (Urgent), 2008-9 (Phase1), 2010-11 (Phase2-1), 2012-13 (Phase2-2), 2014-17 (phase 2-3, including updated R&D plans). Major results until this year for the five tasks were obtained in accordance with the research programmes set out in the PA documents. The future programs were made by considering the peer review comments on 2012, and were also made through a series of close discussions with JA DEMO design team from the viewpoint of contribution to the design.

The results of R&D activity by EU were reported as follows: Material programmes focus on the development of materials for a future DEMO reactor in 2014-2018. One of the priorities is closing the knowledge gaps (Material database, Codes & Standards). The final goal is to develop and improve materials for specific roles into a DEMO reactor and to provide all needed information about those materials to designers.

The results of DDA by JA and EU for the past three years were reported by DDA-leader (This summary was presented in the 1st DEMO Review Meeting on 7th October after this meeting). The following topics of common interest were discussed: development of system code, analysis of DEMO design points, vertical stability, design parameter, heat exhaust and remote maintenance.

On-going activities and plans for future work on breeding functional materials were reported as follows: Concerning R&D on advanced neutron multiplier (T4), to fabricate the Be12Ti beryllide pebbles, a new granulation process has been established that combines

a plasma sintering method for beryllide synthesis, a rotating electrode method (REM) using a plasma-sintered electrode for granulation, and a homogenization treatment by annealing. Concerning R&D on advanced tritium breeder (T5), to granulate Li2TiO3 with excess Li, a new granulation process of emulsion method has been established. The optimized pebbles with up to 5 μm of grain size exhibited good tritium release behavior not only from the viewpoint of chemical form of released tritium but also considering the tritium recovery rate. This recent progress indicates that the basic fabrication methods of advanced breeding functional materials have been established. In the phase 2-3, optimization studies for mass production are being performed based on the results of characterizations, and some R&D results will be fed into DEMO design activities.

On-going activities and plans for future work on structural materials were reported as follows: An assessment of the database needed for design activities was proposed as collaboration between EUROfusion (EU) and Japan in Material research. Database integration to assess the issues on irradiation data for design, and ion irradiation and microstructural analyses to assess the protocol for using fission data for design will be conducted. Post-BA collaboration was proposed; SSTT (Small Specimen Test Techniques) standardization, which is indispensable to qualify irradiation data for design, and HFIR irradiation, which is a key to accumulate missing irradiation data identified in gap analyses. Both need deep interaction with design activity to identify the issues and have consistency in direction of material R&D.

The forthcoming DEMO Review Meeting was discussed and it was noted that the preparation of the Intermediate Report on DEMO Design Activity (IRDDA) is requested in 2014. IRDDA provides us a good opportunity to consolidate the common views and design issues to be resolved and will be a base of Final Report to be submitted in May 2017.

Results on advanced neutron multipliers in EU were reported as follows: Titanium beryllide Be12Ti showed some advantages compared to pure Be under neutron irradiation (lower swelling, better characteristics of tritium release). Several Be-Ti rods were fabricated by extrusion of encapsulated Be-Ti powder at 700°C. Some additional tests on extrusion of Be-Ti powder will be performed till the end of 2014. Study of mechanical behaviour at elevated temperatures of Be-Ti samples from Japan has been started.

Results on Advanced Tritium Breeders in EU were as follows: The facility KALOS enables the production of ~1 kg of pebbles per day. The process control, inter alia with optical control was enhanced and the yield was increased to 80%. The pebble composition was changed by adding LMT (Lithium MetaTitanate). The mechanical properties were improved and pebbles had very good long-term stability for 30 mol% LMT. Re-melting seems appropriate for reprocessing and impurities originate mainly from raw materials (except noble metals). Simulations to demonstrate the possibility of a multiple use of pebbles were performed.

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Group photo of JTCM-3 in Barcelona