§17. Summary of Key Element Technology Verification and Preparation for Engineering Validation of Intense Neutron Source

Matsui, H. (Tohoku Univ.), Sugimoto, M. (JAEA), Muroga, T.

Development and qualification of materials is one of the two most important tasks together with the ITER project for the realization of fusion DEMO plant. In Japan, university research groups, along with JAEA researchers, have been deeply involved in the development of intense fusion neutron source for more than two decades. These neutron sources have been called with different names and the activities have been supported mainly by the NIFS collaboration programs. University activities for the Key Element technology Phase, KEP of the International Fusion Material Irradiation Facility, IFMIF has also been supported by NIFS collaboration. The next phase of IFMIF activity, i.e. EVEDA (Engineering Validation and Engineering Design Activities) has been adopted as one of the projects to be conducted under the Broader Approach framework, and the dedication of Japanese university people for this project is essential for its success.

According to the IFMIF Comprehensive Design Report, CDR [1], prepared by the IFMIF international team in 2004, the primary mission of the IFMIF will be to generate a materials irradiation database for the design, construction, licensing, and safe operation of a Fusion Demonstration Reactor (DEMO). This will be achieved through testing and qualifying materials performance under neutron irradiation that simulates service up to the full lifetime anticipated for DEMO. Tests of blanket elements will be an important use of the facility, and will complement the tests of blanket test modules in the ITER.

IFMIF has been pushed forward so far under the Implementing Agreement on Fusion Materials Development under the umbrella of IEA collaborating agreements since 1995. The KEP has been successfully completed in 2002, and in the two subsequent years were devoted to follow-up activities and to prepare for the EVEDA phase. In the past five years, major accomplishments have been made in each of the four areas of IFMIF development, i.e. a) accelerator system, b) target system, c) test facility and d) design integration and conventional facility. In Japan, these activities have been equally shared by universities and JAEA, the implementing agency for Japan. The activities of universities have been supported by the NIFS program namely LHD Project Collaboration Research since 2005.

The Broader Approach for Fusion Development framework has been signed between the governments of Japan and EU in 2006, and the EVEDA activities will be conducted under this new umbrella. The Japanese domestic framework to implement these activities including universities have been discussed in a special committee hosted by the MEXT, and it is anticipated that several university research groups will be incorporporated in the EVEDA activity.

Objectives of the EVEDA phase are 1) to conduct engineering designing detailed enough to make decision of IFMIF construction, 2) to do demonstration tests in order to technically validate the engineering design, and 3) to examine IFMIF facility operation methodology. EVEDA activities will be implemented under Broader Approach Agreement by EU and Japan, and the site for IFMIF-EVEDA activities will be in Rokkasho, Aomori-Prefecture, Japan. Among the major “engineering validation tasks” are test cell design tasks, Li-target related tasks, and small specimen test technology tasks. Main part of these tasks are expected to be done by Japanese university research groups because of their experties and experience in the IFMIF activities in the past.

In the reference schedule, the EVEDA phase will last for seven years and the construction of the first accelerator will last for 6-7 years, then the first beam with 125mA will become available probably in 2019. After three more years of second beam line construction, the full beam with 250mA will become available. Twenty years of operation is planned with an optional ten years of extension. There is an accelerated version of IFMIF development, i.e. the “optimized” EVEDA approach, where two accelerators will be constructed more or less at the same time and full beam will become available three years earlier than the reference schedule[2]. Since the date of data delivery is rather late for the designing of DEMO under current schedule, it would be beneficial if the accelerated schedule could be adopted.

References

[1] IFMIF Comprehensive Design Report, January 2004. Available at the website: http://www.iea.org/dbtw-wpd/textbase/techn¥o/technologies/index_fusion.asp

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