

§5. Examination of Materials Irradiation Test Program Using Intense Neutron Source (IFMIF)

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The major mission of IFMIF is described in the Comprehensive Design Report published in January, 2004, as follows: “The primary mission of a fusion irradiation facility will be to generate a materials irradiation database for the design, construction, licensing, and safe operation of a Fusion Demonstration Reactor (DEMO).” The focus is obviously on materials while it is also emphasized that “Tests of blanket elements will be an important use of the facility, and will complement the tests of blanket test modules in the International Thermonuclear Experimental Reactor (ITER).” Thus, the mission of IFMIF is not limited to materials but is to cover a wider range in the fusion technology area. For the construction of IFMIF itself, there are a number of technical issues to be addressed. These issues are related to technical areas such as: accelerator system, RF power system, liquid metal handling, heat management system, neutronics, remote handling, etc. These technical areas are also quite relevant to the construction of fusion power systems.

In the IFMIF activities so far, in the Key Element Technology Phase (KEP) in particular, a number of technical issues in those areas as listed above have been addressed. The outcomes of these activities have been already presented in some of the international conferences related to fusion development. They are sufficiently convincing for the project to move on to the next phase of Engineering Validation/ Engineering Design Activity, i.e. EVEDA phase. The current projected IFMIF schedule is shown in Fig. 1.

The objective of the present activity is to examine the materials irradiation test program using IFMIF based on the results on small-specimen test technology and advanced design of irradiation test cell obtained through the KEP activity.

In the KEP activity, database has been obtained on the size effects of pre-cracked bend bar specimens and compact-tension specimens for Reduced Activation Ferritic/Martensitic Steels (RAFMs). These results will be used for standardization of the test specimen geometry for application to IFMIF.

The materials irradiation program needs to be consistent with other fusion programs such as breeding blanket development and DEMO licensing and construction. In Japanese fusion materials development strategy, the candidate structural materials are categorized into reference and advanced materials. As the reference materials, RAFMs were selected because they have the most matured industrial infrastructure. Development of the reference materials is crucial for realization of DEMO in timely manner. On the other hand, vanadium alloys and

SiC/SiC were nominated as the advanced materials, which will contribute to increasing attractiveness of the fusion system in terms of cost of electricity and environmental benignity. It is recognized that the development of the advanced materials must also be enhanced now, due to the long lead time necessary for their development.

For the qualification of materials up to the full lifetime of DEMO and Power Plant Reactors, irradiation testing with IFMIF is recognized to be essential. The Test Blanket Module (TBM) to be installed in ITER is also considered to be an important milestone for technological integration. A roadmap of materials development is under construction. The materials development is planned to proceed with IFMIF and ITER in a coordinated way. Early period of IFMIF testing will be dominated by testing of RAFM for obtaining irradiation data to be applied for designing DEMO. For advanced materials, small scale testing will be carried out in initial operation period of IFMIF and ITER-TBM followed by full size testing.

The materials irradiation test program for IFMIF will be made based on the materials development strategy and technical database on small-specimen test technologies.

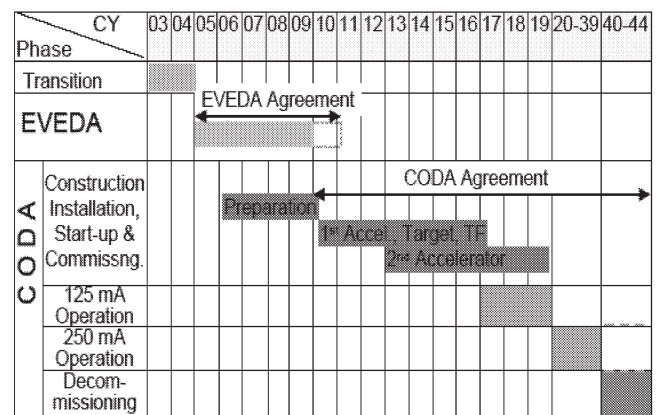


Figure 1. Projected IFMIF schedule.