IFERC Newsletter

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Summary of BA Phase I

Summary of IFERC project in BA Phase I

The IFERC project is the one of three projects of the Broader Approach (BA) Activities, and started in June 2007 as well as IFMIF/EVEDA (International Fusion Materials Irradiation Facility/Engineering Validation and Engineering Design Activities) project and STP (Satellite Tokamak Programme, JT-60SA) project. The IFERC project was composed of DEMO Design and R&D Coordination Centre (DEMO Design and DEMO R&D), Computational Simulation Centre (CSC), and ITER Remote Experimentation Centre (REC) with the Site Activities for infrastructure. The original schedule of the BA Activities (from June 2007 to May 2017) was extended up to the end of March 2020 as the BA Phase I period, due to overall administrative consideration.

Achievements of IFERC project should be mentioned from three aspects; construction of facilities and provision of equipment, the research results, and the administrative matters.

Regarding facilities, the Administration & Research Building, the CSC & REC Building, the DEMO R&D Building and the DEMO Joint Research Building were constructed between 2007 and 2016 as shown in Fig.1,

Fig. 1 Overview of IFERC site. The buildings in the left side were constructed as a part of IFERC project.

where the DEMO R&D Building for materials analysis is a world top-level unique facility handling RI, Beryllium and Tritium simultaneously. Helios supercomputer shown in Fig.2 was successfully installed as the CSC equipment in the end of 2011, recovering from the effects of the Great East Japan Earthquake. Helios operation took place from Jan. 2012 to Dec. 2016 as planned. The REC equipment for remote participation shown in Fig.3 was also prepared by 2017 based on the Overall plan of REC created in 2012. All the activities for construction of facilities and provision of equipment were accomplished on time and on budget.

Fig. 2 Helios supercomputer as CSC equipment

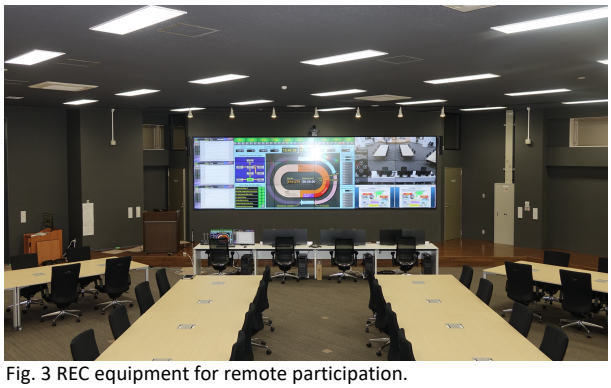

Fig. 3 REC equipment for remote participation.

Regarding the research results, all the planned activities of IFERC project have been completely accomplished on time and on budget. The results were disseminated in above 1500 peer-reviewed publications. The details are as follows:

- DEMO Design Activity,

The final report was issued in Feb. 2020. In total, 557 papers have been published. The ratio among EU/JA joint papers, EU papers and JA papers is 3%, 86% and 11%, respectively. As their main achievements, the pre-conceptual design of EU and JA DEMO was shown including device parameters indicated in Table 1 below. Also, critical design issues were identified and R&D tasks to find feasible solutions were specified.

- DEMO R&D Activity,

The final report was issued in Dec. 2017. In total, 291 papers have been published. The ratio among EU/JA joint papers, EU papers and JA papers is 7%, 15% and 78%, respectively. Their main achievements are as

follows: 1) Tritium technology: Various techniques were developed by using the world-class unique facility in Rokkasho shown in Fig.4 below, 2) Structural materials: F82H in JA and EUROFER97 in EU were characterized and optimized, which is leading to MPH, 3) Functional materials: In-house fabrication techniques of advanced neutron multiplier and advanced T-breeders were established, and the characterization was performed, and 4) SiC_f/SiC composites: The R&D activities resulted in fundamental database of mechanical/physical/ chemical properties.

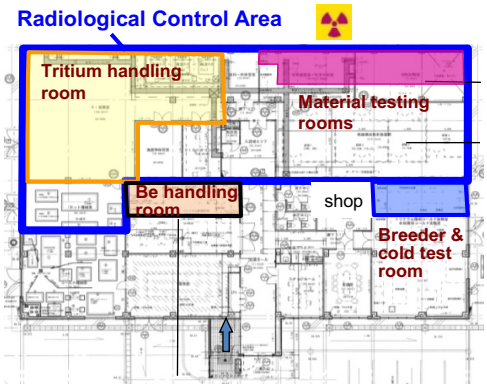

Fig.4 DEMO R&D building with Radiological control area

- JET-ILW analysis in DMEO R&D,

The final report was issued in Des. 2019. In total, 13 papers have been published as EU/JA joint papers. As their main achievements, the characterization of dust and tile samples of JET-ILW shown below was implemented for ITER as only experimental evidence of T-retention in a tokamak.

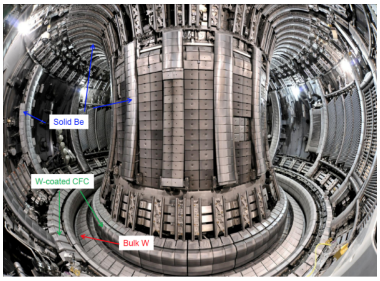

Fig.5 JET ILW

- CSC Activity,

The final report was issued in Oct. 2017. Dedicated machine to magnetic fusion research; Helios was provided and operated with a very high availability and usage rate as shown in Fig.6. In total, 693 papers have been published by (partially) using Helios. The ratio among EU/JA joint papers, EU papers and JA papers is 9%, 66% and 25%, respectively. Published papers were seen in a wide range of activities from plasma physics to reactor materials and technology.

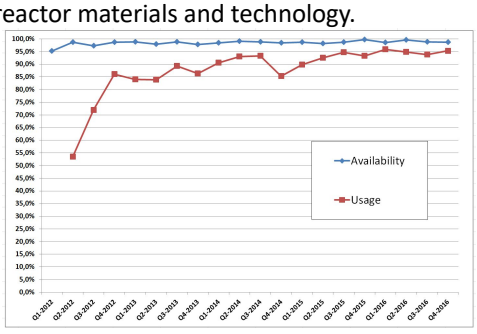

Fig. 6 Usage and availability of Helios

- REC Activity,

The final report was issued in Dec. 2019. In total, 8 papers have been published as EU/JA joint papers. As the main achievements, a remote facility for remote participation in ITER experiments was prepared in Rokkasho and the functions of hardware and software developed were verified with WEST, JET and JT-60SA, and the demonstration of the remote participation with WEST experiments were successfully implemented in Nov. 2018 as shown in Fig. 7 below.

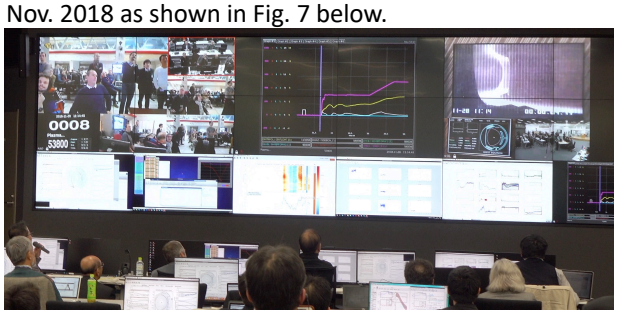

Fig.7 Remote participation in WEST experiments

Table 1 Main design parameters of EU and JA DEMOs

Parameters	EU(DEMO1)	JA (2014)
Major/minor radius, R_p(m)/a(m)	9.1/ 2.9	8.5/ 2.4
Aspect ratio, A	3.1	3.5
Vertical elongation, κ_{95}	1.59	1.65
Plasma current, I_p (MA)	19.6	12.3
Fusion power, P_{fus} (GW)	2	1.42
Net electricity, P_{el} (MW)	500	~200
Magnetic field, B_T (T)/ B_{max} (T)	5.7/12.3	5.94/12.1
Beta normalised β_N	2.6	3.4
Confinement enhancement, HH_{y2}	1.1	1.3
Bootstrap current fraction, f_{bs}	0.35	0.61
Normalised density, n_e/n_{GW}	1.2	1.2
P_{sep}/R (MW/m)	17	< 34
Neutron wall load (MW/m^2)	1	1
Operation	Pulsed/ 2 hrs	Steady-state

As administrative aspect, documents related IFERC project have been managed and stored in the Document Management System (DMS) and all the types of contributions; in-kind, in-cash and human contribution and the accounting were handled by using the Credit Management System (CMS). All the contributions by both EU and JA were completely accomplished on time and on budget.

In conclusion, IFERC project fulfilled successfully its mission in BA Phase I, and achievements in BA Phase I will become the basis of IFERC project in BA Phase II starting in June 2022.

(Noriyoshi Nakajima, IFERC Project Leader in BA Phase I)