Status of ITER construction and KO procurement activities

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1. ITER Project for fusion energy

Fusion is the mass-to-energy conversion that occurs in the core of the Sun and all the stars. It is the most powerful source of energy in the universe. Every second, our Sun fuses 600 million tons of hydrogen into helium. It is the fusion reaction that gives the Earth light and warmth. The ITER project mission is to provide the scientific and engineering feasibility of fusion energy by achieving extended D-T burning plasma of several hundred seconds in 2030ss, now in its construction phase with the target date of the first plasma in Dec. 2025 [1].

The ITER International Fusion Energy Organization, a collaboration of seven members (China, Europe, India, Japan, Korea, the Russian Federation and the USA) representing 35 countries and more than half the world's population, is on its way to recreating the energy source of the Sun here on Earth. Established by the signature of the ITER Agreement in November 2006, the ITER project is a critical step in the development of fusion energy: its role is to confirm the feasibility of exploiting magnetic confinement fusion for the production of energy for peaceful purposes by providing an integrated demonstration of the physics and technology required for a fusion power plant.

By its fundamental nature, ITER is a challenging project, due to its size, technological complexity, long timeline and consequent high cost. It is even more challenging because the ITER Agreement required a unique multinational structure: the ITER Organization serves as owner and coordinator of the whole ITER program as well as the nuclear operator; and seven domestic agencies are in charge of 90% of the value in the form of procuring the components of the ITER installation. The main tokamak component of ITER machine is shown in Figure 1.

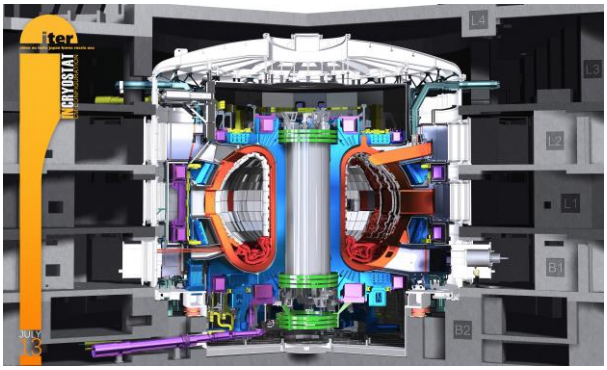

Figure 1 ITER Tokamak Machine

2. Status of ITER construction

The ITER is a first-of-a-kind fusion reactor and facility, which are under construction in Saint Paul-lez-Durance of France by the international collaboration. Europe will contribute to almost half of its construction, while the other six Members will contribute equally to the rest. The worksite of the ITER construction and main Tokamak complex are shown in Figure 2 and 3, respectively.

Construction of the facility is advancing both at the ITER site and in factories around the world: for example, elements of the superconducting magnets are being produced by industry in 6 of the partners, while the vacuum vessel will be assembled from components fabricated by 4 of the partners. Agreements covering ~90% of the facility's 'in-kind' value have been signed between the IO Central Team and the IO Domestic Agencies, and delivery of large components to the ITER site is already under construction. R&D prototyping and testing of major elements of systems such as plasma facing components, heating and current drive systems, remote handling and power supplies are also at an advanced stage. Significant progress is being made in the Test Blanket Module (TBM) Program, which will test concepts for breeding blanket technology for Demo: formal agreements for the construction 6 TBM Systems have now been concluded between the IO-CT and the responsible IO-DAs and the conceptual designs are under review. Following the successful application for creation of the ITER Basic Nuclear Installation (INB-174), ITER management is focussed on implementing the project within the appropriate safety framework.

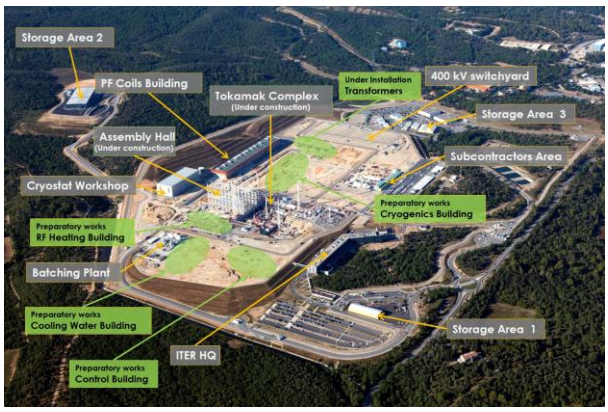

Figure 2 Worksite of ITER construction

Figure 3 Tokamak complex under construction

2. Status of KO procurement activities

After joining to the ITER project in June 2003, Korea established the National Fusion Research Institute (NFRI) and also established the ITER Korea Domestic Agency (KODA) under the NFRI in September 2007.

At that time, the next generation fusion energy demonstration reactor (DEMO) was actively discussed to further accelerate the commercialization of fusion energy. Korea announced a National Fusion Roadmap in 2005 so that an economically viable demonstration fusion power plant can be operated during the 2040s [2]. Furthermore, Fusion Energy Development Promotion Law (FEDPL), the first legal act in the world for fusion energy development, was enacted in 2007 to promote a long-term cooperative fusion research and development among participating industries, universities and research institutes.

The KODA is responsible for all activities related to the ITER Project in Korea. It has performed various procurement activities including engineering design, mock-up tests, and manufacturing for KO procurement items. Figure 4 shows the in-kind contribution to ITER project in Korea; 10 ITER procurements and one additional voluntary item named as Test Blanket Module (TBM). Figure 5 shows the procurement schedule of the KODA which was recently rearranged in accordance with newly established First Plasma Schedule based on the Staged Approach in IO in 2016.

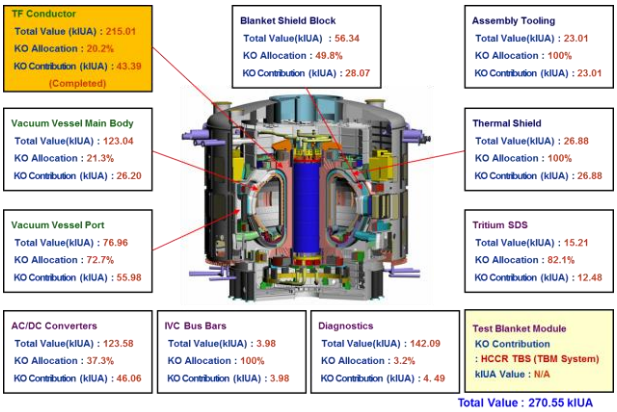

Figure 4. KODA in-kind contribution to ITER project.

Figure 5 Procurement schedule of KO procurement

Among the KO procurement, the toroidal field (TF) magnet conductor procurement, the first one between IO and the ITER Korea in 2008, has been already accomplished at the end of 2014. Currently, other major procurement packages including vacuum vessel sectors and ports, thermal shields, assembly tools, and AC/DC converters are in significant progress and under full manufacturing status by its suppliers, enabling their schedule milestones and technical specifications to be accomplished. In this presentation, the status of the KODA procurement activities, including technical challenges and works were delivered.

3. Conclusions

ITER is the largest and most powerful controlled fusion device ever built. When finished, it will allow us to demonstrate the scientific and technological basis for large scale fusion energy. The purpose of ITER project is to demonstrate the scientific and technological feasibility of fusion power. By joining the ITER Project, Korean fusion community will build industrial infrastructure and human resources aiming to develop DEMO and the commercial fusion power plant in the future. The KODA is responsible for all activities related to the ITER Project in Korea. It includes various procurement activities and R&D activities such as TBM program.

REFERENCES

[1] ITER Homepage, http://www.iter.org/.
[2] M. Kwon, Y.S. Na, J.H. Han, S. Cho, H. Lee, I.K. Yu, et al. Fusion Engineering and Design, 83 (2008), p. 883