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Position Statement（View, Suggestion, Explanation, Others）

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Atomic Energy Society of Japan

Fusion Engineering Division

The ITER Project

Introduction

Since ancient times, humans have utilized the energy from the sun shining down from high above. Now, research and development projects are ongoing throughout the world to realize the potential of the sun's energy here on Earth and create a process from which to extract energy (fusion energy). Fusion energy is an attractive energy source that has the potential to solve global challenges humanity is currently facing, such as the need for increased energy production, while also protecting the environment.

However, here on Earth, it is difficult to realize the potential of the nuclear fusion reaction that occurs in the sun. Therefore, small solar-like nuclear fusion energy generators (called nuclear fusion reactors) are being developed to realize a process similar to that of the sun here on Earth.[1)]

These fusion reactors use hydrogen isotopes for fuel and their fusion reactions are initiated by confining the fuel in a strong magnetic field. This reaction is an inherently safe process and does not generate carbon dioxide which contributes to increase global warning, and its fuel resource is inexhaustible.

In the current research and development phase of nuclear fusion reactors, the “tokamak” design is the most promising with its proven track record. The most recent and largest tokamak is the “experimental reactor” ITER (meaning “the way” in Latin), which is an international collaborative project and is also a part of the nuclear fusion energy development strategy of Japan. The mission of the ITER Project is to demonstrate the scientific and engineering feasibility of nuclear fusion energy. Once ITER’s mission is complete, the next stage in nuclear fusion development would be the realization of a commercial fusion power plant, the “prototype reactor” DEMO, by the mid-21st century.

The background, objective, current construction status, and Japanese contributions to the ITER Project are presented below.

Background and objectives of the ITER Project

The ITER Project originates from the 1985 Geneva Summit between US President Reagan and General Secretary Gorbachev of the Soviet Union. The two leaders agreed to

jointly design an experimental fusion reactor for the development of fusion energy as a symbol of peace towards the end of the Cold War era. After this agreement, Japan and Europe joined the project, and joint conceptual design work between Japan, the US, Europe (Euratom), and the Soviet Union started in 1988.

Following the conceptual design were increasingly detailed engineering design phases, which began in 1992 and focused on the major components that needed to be developed before ITER could even begin construction. An international team consisting of experts from Japan, the US, Europe, and Russia collaborated on the design, allocated the necessary research and development activities of the major components between the members, and eventually finalized the engineering design and were able to successfully fabricate full-scale mockups of the major components by 2001. Finally, the feasibility of actually constructing ITER had been proven.

More members (Korea, China, and India) joined the ITER Project, and a final decision on the location of the ITER construction site was made, with the members agreeing on Cadarache in southern France. An international agreement for implementing the ITER Project was ratified, after which ITER construction finally began in 2007. The ITER Project has been developed with the following main three goals in mind to demonstrate the scientific and technical feasibility of nuclear fusion energy.

1. Demonstrate an extended nuclear fusion plasma burn (about 400 seconds). Fusion power having a Q value (output energy divided by input energy) of greater than 10.

2. Demonstrate the engineering technologies required of nuclear fusion reactors for burning plasmas.

3. Perform tests to recover thermal energy from the fusion energy generated by the fusion reaction. Test tritium fuel recycling, or tritium breeding.

Current status of the ITER Project and Japanese contributions

The ITER machine will be constructed, operated, and decommissioned under an international treaty (The ITER Agreement) signed by Japan, the US, EU, Russia, Korea, China, and India.

The ITER Agreement is a 35-year-long treaty stipulating the establishment of the ITER Organization, which is the implementing entity of the ITER Project, the rights and

obligations of the member parties, and the various contributions of the domestic agencies of each member party. The ITER Agreement entered into force on October 24, 2007, and the ITER Organization (Director General Kaname Ikeda) was officially established on the same day. The ITER Project is an international research and development project based on the collaboration of the ITER member parties. The total populations of the current member parties are equivalent to more than half of the world's population and more than three quarters of the world's gross domestic product (GDP)—a truly global project.

About 90% of the components needed for the construction of ITER are procured and delivered to the ITER site by the member parties through their respective domestic agencies. The Japanese government has designated the National Institutes for Quantum and Radiological Science and Technology (QST) as the domestic agency of Japan. QST, in cooperation with industry, plays an active role in the ITER Project by procuring the major components for ITER, such as the superconducting magnet coils, plasma heating devices, remote handing devices, plasma facing components, and air detritiation systems, all of which are extremely high-tech components.

Furthermore, the Japan domestic agency facilitates, promotes, and contributes to the ITER Project by acting as the correspondent for recruiting and dispatching Japanese nationals to the ITER Organization. By participating in conferences, such as the Fusion Energy Forum, with both academia and industry, we can influence public awareness of and potentially increase Japan's contributions to the ITER Project, which in turn will benefit Japan extensively through the discoveries and achievements made.

Summary

By participating in the ITER Project, Japan can expand upon technologies and engineering know-how for fusion reactors, fusion reaction control, and also foster human resources. Using the resources and knowledge gained from the ITER Project, we hope to realize commercial nuclear fusion energy in the near future. We, the Fusion Engineering Division, fully support the ITER Project and will spare no effort in providing necessary assistance and cooperation as one of the leading countries in fusion research and development. The ITER Project is a long-term research and development project 35 years in the making, and the participation of younger generations to maintain these past efforts is essential. Finally, we, the Fusion Engineering Division, invite and will fully support the new generation to participate in the ITER Project.

For more information

○To learn more about the ITER Project, component procurement, and Japanese activities

① Ministry of Education, Culture, Sports, Science and Technology in Japan HP: http://www.mext.go.jp/a_menu/shinkou/iter/main.htm

②QST-ITER HP: http://www.fusion.qst.go.jp/ITER/

③ITER Organization HP: https://www.iter.org

○Information for ITER agreement

Ministry of Foreign Affairs in Japan:
http://www.mofa.go.jp/mofaj/gaiko/treaty/shomei_19.html

○Information for Fusion Energy Forum of Japan HP

Fusion Energy Forum of Japan HP:
http://www.fusion.qst.go.jp/fusion-energy-forum/

○SNS of QST-ITER

1) Fusion reactions are reactions in which two or more lighter atomic nuclei are combined to form one heavier atomic nuclei and subatomic particles. The fusion reaction that occurs in the sun combines hydrogen nuclei to form helium, whereas the nuclear fusion reaction that occurs in reactors here on Earth combine deuterium and tritium nuclei to form helium and neutrons.