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National strategies of Japan - Fusion research and development strategy for JA DEMO

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Japanese fusion program has three stages for realization of fusion energy, i.e. establishment of physics/engineering bases, fusion energy production and electricity production. We are in the stage of fusion energy production, where QST is contributing to the ITER project for the demonstration of 500 MW fusion energy production with Q=10. QST is also implementing the Broader Approach (BA) Activities in EU-JA collaboration for support and supplement of the ITER project. QST aims at early transition to the next stage of electricity production by integrating the ITER project, the BA activities and domestic activities. In the next stage, construction of JA DEMO is planned, where electric power of >100 MW will be generated.

Recently, research and development activities for the realization of fusion energy are globally being accelerated both in public and private sectors from the perspective of the transition towards a Net-Zero Society. In Japan, "Fusion Energy Innovation Strategy"was formulated in Cabinet Office as Japan's first national strategy for fusion energy in April 2023. This strategy presents the vision of "Commercialization of fusion energy"and highlights development of the fusion industry as well as development of fusion technology. In order to promote the strategy, it is required that establishment of framework for conducting R&D by bringing together, centering on QST, academia and private companies (fusion technology innovation hub). Furthermore, "Integrated Innovation Strategy 2024 (Cabinet decision)"stated that "Japan will aim to realize fusion energy as soon as possible by preparing a timetable that includes necessary national efforts toward achieving the first demonstration of power generation in the 2030s ahead of other countries". Considering the present situation, the revision of Fusion Energy Innovation Strategy is planned this spring.

In accordance with the recent situation described above, QST is investigating phased approach strategy to accelerate JA DEMO program with the same TFC size as ITER. The objective for each phase is demonstration of electricity production with almost zero net electric power in Phase I; demonstration of tritium breeding with breeding blankets in Phase II; and demonstration of steady-state operation with 100 MW level net electric power using high □ and high confinement plasma as well as improved breeding blankets and heating system in Phase III. As phase changes, enhanced plasma performance, improved blankets and high efficiency heating system are required. In order to utilize key technologies acquired through the ITER project and the BA activities for the acceleration of the DEMO project, QST has proposed to enhance facilities and equipment in Rokkasho and Naka Institutes such as facilities of fuel cycle, blanket, neutron source, superconducting magnet, plasma heating.

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