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Validation of Tritium Self-Sufficiency of DEMO

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The authors have suggested that realistic Power Ascension Tests (PAT) of DEMO can produce its tritium to be needed in the series of tests by its own operation from initial DD discharge until reaching steady state full power burning with no external supply. It is generally understandable that closed tritium fuel plant can collect small amount of tritium to be produced by DD and DT reaction and breeding in the lithium containing blanket within reasonable dwell operation following each discharge to be anticipated in realistic operation scenario. Fuel system was described by a system dynamics model, and analyzed considering realistic PATs of DEMO, that will be mainly pulsed DD and low concentration DT. Primary fuel cycle is composed of plasma exhaust evacuation, isotope separation by cryogenic distillation, storage and blanket tritium recovery. Secondary systems is such as tritium recovery from water and solid waste, secondary confinement to capture permeated and leaked tritium are also considered. Tritium returning time constant varies depends on the function of the each components, and finally collected at the storage after the staged recovery from the components according to their tritium release time constant.
Although no actual PAT plan for fusion DEMO is available, previous PATs for new fission reactors and recent consideration of ITER operation plan can provide sufficient possible scenario of initial commissioning operation of DEMO. Typical PATs will require years of operation from zero power that would be DD discharge, with pulsed power output and long dwell time between them. Output power will gradually be increased in PATs to check the functions of reactor systems and components. Although components of the tritium fuel cycle in the primary loop can be anticipated based on the previous tokamak operation experience and Tritium System Test Assembly at LANL, breeding blanket would be the most unknown and critical components on this fuel self-sufficiency of the DEMO reactor. Possible validation experiments and methodology to measure actual tritium production capability with satisfactory accuracy will be presented.

Eligible for student paper award?

No

Authors: Prof. KASADA, Ryuta (Institute of Advanced Energy, Kyoto University); Prof. KONISHI, Satoshi (Institute of Advanced Energy, Kyoto University)

Presenter: Prof. KONISHI, Satoshi (Institute of Advanced Energy, Kyoto University)

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