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P2.190 Li-rod structure in high-temperature gas-cooled reactor as a tritium production device for fusion reactors

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To start up an initial fusion reactor and for technical tests for tritium circulation and blanket system, it is necessary to provide sufficient amount of tritium from an outside device. Tritium production using a high-temperature gas-cooled reactor has been proposed. [1]. It was reported that 500–800 g of tritium could be produced during one year of operation using a 600 MW thermal output high-temperature gas-cooled reactor [2]. If we can keep the Li-rod temperature below 800 K during the operation, the tritium outflow from the Li rods to He coolant could be suppressed to less than 1% of the amount of the tritium produced. When we attempt to operate the reactor at a higher temperature range (e.g. 1100-1200 K) from the viewpoint of electric power generation efficiency, the outflow will be increased. It is important to devise a way to reduce the outflow to further low level.
In this paper, we assume the tritium production using HTTR (High Temperature engineering Test Reactor). Amount of tritium produced was evaluated using continuous-energy Monte Carlo transport code MVP-BURN [3], and tritium containment using diffusion equation. Nuclear data were taken from JENDL-4.0, and tritium permeability and absorption data were taken from our experiment. The purpose of this paper is to clarify a suitable structural design of the Li-rod from the viewpoints to produce sufficiently large amount of tritium and to securely contain the tritium produced in the Li-rod during the standard reactor operation with 1100-1200 K rod temperature.

[1] H. Matsuura, et al., Nucl. Eng. Des. 243 (2012) 95.
[2] X. Yan, et al., Nucl. Eng. Des. 222 (2003) 247.
[3] Y. Nagaya, et al., JAERI 1348 (2005).

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