FUEL SYSTEM of DEMO-FNS TOKAMAK taking INTO ACCOUNT THE CHARACTERISTICS OF THE HYBRID BLANKET

S.S. Anan’ev, A.V. Spitsyn, and B.V. Kuteev

National Research Centre Kurchatov Institute, Moscow, Russia, ananyev\_Ss@nrcki.ru

As a part of the nuclear energy Research Center "Kurchatov Institute" development a program of creating a hybrid reactor combining nuclear and thermonuclear technologies was developed and proposed. The basis of a thermonuclear fusion reactor is neutron source (TIN) based on the tokamak [1]. The main difference from the TIN DEMO demonstration fusion reactor is that TIN is not necessary to achieve fusion plasma ignition conditions, and sufficient to obtain the neutron yield comparable to injected power auxiliary heating. In contrast to the pure fusion reactor without fissile material, the required power of thermonuclear reaction can be up to 100 times less due to the fact that most of the energy comes in a subcritical blanket due to fission reactions, which significantly reduces the requirements for the parameters of the tokamak plasma and materials.

TIN is a key system and hybrid reactor should provide steady flow of fusion neutrons with a capacity of 10–50 MW, which reached close to the pulse values ​​of existing installations JET and JT-60U. Fuel cycle technologies (FC) is one of the key elements for the TIN. FC systems should provide treatment and storage of deuterium and tritium, as well as the processing of the fuel mix in all systems of a thermonuclear reactor. These technologies have to be developed significantly, because the technical solutions chosen ITER project can be used in TIN is only partially due to steady state operation of the plant, the higher neutron fluxes and fluxes of tritium fuel cycle elements.

To assess the distribution of tritium in fusion reactor systems and components "tritium plant" is necessary to carry out a dynamic simulation of all system elements allowing for the operation of the tokamak. Such calculations are now performed using the code «FC-FNS» [2]. The code allows the calculation of tritium flows and stocks in tokamak fusion systems. The code takes into account the mechanisms of loss of tritium in the fuel cycle due to thermonuclear burnup and decay in all systems. Code upgraded in the direction of expansion systems purification of hydrogen isotopes from toxic industrial gases and liquids, and in the direction considered study systems. To close the FC processes of tritium in the hybrid blanket was considered.

The report is a conceptual diagram of a stationary fuel cycle TIN with 3–50 MW of fusion power, given current estimates of the distribution of tritium in fusion reactor systems and components "tritium plant." The calculations for the neutral injection systems TC module and tritium breeding.

References

1. B.V. Kuteev, at al. // Published 26 June 2015 © 2015 IAEA, Vienna Nuclear Fusion, Volume 55, Number 7.
2. Anan’ev S.S. et al. Concept of DT fuel cycle for a fusion neutron source // Fusion science and technology vol. 67 mar. 2015