CONCEPT OF DT FUEL CYCLE FOR A FUSION NEUTRON SOURCE DEMO-FNS

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Technology of fusion DT fuel cycle is one of key elements for a next-step steady steady-state tokamak with fusion output more than 10 MW like DEMO or fusion neutron source (FNS) [1]. This technology should be significantly developed as technical solutions selected in the ITER project may be used in such devices only partially due to higher capacity factor for a steady-state reactor, high neutron fluxes, temperature and tritium flows in the fuel cycle elements.

FNS is of interest for many applications: (i) basic and applied research (neutron scattering, etc); (ii) testing the structural materials for fusion reactors; (iii) control of sub-critical nuclear systems and (iv) nuclear waste processing (including transmutation of minor actinides). Project DEMO-FNS [1] designed for to demonstration fusion and hybrid technologies and require technology with resource up to 5000 hours/year, remote maintenance, significant amount of tritium in the fuel cycle systems.

In the paper describes a DT-fuel cycle concept for a steady-state fusion neutron source (FNS) based on tokamak [2]. For concept design a code for calculation fuel flux and fuel inventory at subsystems of fuel processing plant and at tokamak subsystems (like neutral beam injection system, pumping and fueling systems) is developed. For demonstration of FNS capabilities a tokamak with major radius R = 2.5 m, aspect ratio A = 2.5, superconductive magnetic coils and energy multiplication factor Q ≤ 1 will be used. The plasma heating, current drive and atoms beam for neutron production will be provided by 500 keV (30 MW) NBI as well as 6 MW of ECRH.

The paper presents calculations for the fuel cycle DEMO-FNS compared with calculations with fuel cycle for FNS-ST [3] and with calculations for the ITER scale.

References

1. B.V. Kuteev et.al., Development of DEMO-FNS Tokamak for Fusion and Hybrid Technologies, In: 25th Fusion Energy Conference (FEC 2014), Saint Petersburg, Russia, 13 -18 October 2014
2. Anan’ev S.S. et al. Concept of DT fuel cycle for a fusion neutron source. — Fusion Science and Technology (in press).
3. B.V. Kuteev et.al., Plasma Phys. Rep. 36 2814 (2010).