CONCEPTUAL DESIGN project OF THE TOKAMAK WITH A DIVERTOR for TRAINING AT THE NRU “MPEI” [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.192

1,2Budaev V.P., 1Dedov A.V., 1,2Savrukhin P.V., 1Fedorovich S.D., 1Komov A.T., 1Karpov A.V., 1,2Martynenko Yu.V., 1Ivanov D.P., 1Gubkin M.K., 1Lazukin A.V., 1Lukashevsky M.V.

1National Research University "MPEI", [budaev@mail.ru](mailto:budaev@mail.ru),  
2National Research Center "Kurchatov Institute”

The creation of a modern training and demonstration base for training specialists is necessary for staffing the thermonuclear power industry being created in Russia [1], construction and operation of a fusion neutron source based on tokamak (FNS) [2], tokamak T-15MD (NRC “Kurchatov Institute”), tokamak with reactor technologies TRT (TRINITI), tokamak ITER, plasma facilities of State Corporation “Rosatom”. In the period up to 2025 and in the future up to 2030 it is required to train about 600 highly qualified engineering and physical engineering staffs for the implementation of FNS, tokamaks ITER, TRT and T-15MD. NRU "MPEI", with its professor’s staff and modern training and experimental facilities, can provide more than half of such engineering staff needs, including highly qualified engineers in vacuum technology, cryogenics, power electronics and electrical engineering, cooling systems, control systems, plasma diagnostics, and experimental physics.

A conceptual design project of the tokamak with a divertor is being developed, which will be constructed at the NRU “MPEI” until 2024. Preliminary design parameters of the tokamak with a divertor as following: major radius ~0.5 m, aspect ratio ~3.2, ellipticity (elongation) ~ 1.8, plasma current ~ 100 kA, toroidal magnetic field ~ 1 T, auxiliary ICR heating.

In addition to training purposes, the research program on this ITER-like tokamak will be implemented on divertor plasma, the development of technologies for tokamak engineering systems exploiting, cooling in-vessel components under high-heat load. The modern divertor technologies will be experimentally tested: the ergodic separatrix mode (snow-flakes), a limiter with magnetic protection, an open/closed asymmetric divertor, a magnetic configuration with negative triangularity, a magnetic configuration with larger aspect ratio, liquid metal lithium technologies for plasma-facing components, technologies for disruption mitigation and vertical displacement instability mitigation. These technologies aimed at steady-state operation of the tokamak should be tested on a laboratory-scale tokamak before being implemented on a large tokamak and in a fusion reactor. There is no such device yet in Russia now, and the proposed tokamak designed at the MPEI will be a necessary step in the design and construction of a thermonuclear tokamak reactor in Russia.

References

1. Kurchatov I.V. On the possibility of creating magnetic thermonuclear reactors. — In: Collection of scientific works, Moscow: Nauka, 2012, vol. 5, pp. 78-81.
2. Velikhov E.P., Kovalchuk M. V., Azizov E. A., Ignatiev V. V., Subbotin S. A., Tsibulsky V. F. Fusion neutron source for the production of nuclear fuel. - Atomic energy, 2013, vol. 114, issue 3, pp. 160-165.
3. Krasilnikov A.V., Konovalov S.V. Fusion technologies: from ITER to next-step experiments. XLVI Zvenigorod conference, 2019, p. 42.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/E/ru/IH-Budaev.docx) [↑](#footnote-ref-1)