The OPTIMIZATION of the VORTEX MAGNETIC FIELD SYSTEM OF THE TOKAMAK MEPHIST-0 [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.070

Vorobyov G.M., Ganin S.A., Efimov N.E., Krat S.A., Kurnaev V.A., Prishvitsyn A.S.

National Research Nuclear University “MEPhI”, Moscow, Russian Federation, [stas.ganin.97@mail.ru](mailto:stas.ganin.97@mail.ru)

The main principle of plasma generation in tokamaks is the use of a central solenoid (inductor) to create a vortex magnetic field. When a vortex magnetic field is created using an inductor in the center of a facility, a vertical magnetic field is formed in the discharge area, which must be suppressed. In the modern tokamaks, the control coils of a poloidal field, which create vertical field that compensates for the field from the inductor, are used. To control the independent poloidal coils complex and expensive control system is needed, as well as magnetic field sensors, and an inductor control system.

Under the conditions of a small facility like the educational demonstration tokamak “MEPHIST‑0”, an alternative solution to the inductor vertical magnetic field compensation problem was proposed and implemented. A number of poloidal coils were connected sequentially with the electric circuit of the inductor. It was proposed that their fields would compensate for the vertical field from the inductor in the plasma area. Due to the sequential connection of the inductor-coil circuit elements, collectively called the tokamak transformer system, it was possible to abandon the complex and expensive power supply and control system of independent coils.

To ensure compensation of the vertical field, the configuration of the transformer coils, specifically, their position, number, and the number of turns in each of the coils was calculated to minimize the total vertical magnetic field from transformer system in the area of the discharge.

Due to the complex geometry of the discharge chamber, influencing the space-time distribution of the magnetic field created by the transformer system inside the chamber, the perfect numerical solution of the problem of optimizing the transformer system was deemed too resource-intensive. For this reason, experiments were carried out to optimize the number of turns in transformer coils. The experimental measurements of the spatial-temporal distribution of the magnetic field inside the discharge chamber were carried out for different variations of the transformer system, which varied relative to the optimal values calculated in the zeroth approximation for a stationary magnetic field without a discharge chamber.

The work is aimed to present the modeling and experimental results that formed the basis of optimization of the system for creating a vortex magnetic field. The optimal configurations of the transformer system are shown for several types of optimization of the magnetic field distribution in the discharge chamber.

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