DEVELOPMENT AND BENCH SIMULATION OF A PLASMA VERTICAL POSITION CONTROL SYSTEM FOR THE T-15MD TOKAMAK [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.091

Khayrutdinov E.N., Khayrutdinov R.R., Dokuka V.N., Sokolov M.M., Igonkina G.B., Kachkin A.G.

National Research Centre "Kurchatov Institute", eduard@khayrutdinov.ru

In the case of stability violation, the vertically elongated plasma in the T-15MD tokamak passes into a vertical displacement event (VDE), which ends with thermal breakdown with the probability of subsequent destruction of the chamber elements. To prevent this phenomenon, optimize the initial phase of the plasma discharge, and control the position of the plasma column, a system for stabilizing the vertical position of the plasma is required. A special winding will counteract the prevention of vertical plasma breakdowns in the T-15MD - HFC (Horizontal Field Coil). The design and application features of this coil impose certain requirements on the speed and quality of control of its power source [1]. To determine the beginning of the vertical displacement, a set of vertical flow sensors is used, which makes it possible to detect a change in the plasma column field during a vertical displacement.

In addition, the special structure of the control loop allows the use of HFC to implement the function of additional field correction.

This means that HFC power management uses two asynchronous high-speed regulators to reassign the control system priority at any time. To obtain optimal timing values, the control loop is implemented in the FPGA. The presented work describes the general composition and technical solutions that were chosen to implement the HFC power supply and control loop. The described solutions were simulated (both the technical component of the power supply and the proposed control method) using the vertical plasma instability model, which consists of the Kirchhoff equations for HFC [2] and the plasma motion equation. The proposed project uses the same principles as the implementation of the T-15MD plasma control system, so the new solution can be easily integrated into the existing system.

References

1. В.А. Альхимович, Е.П. Велихов, В.А. Вершков, А.В. Звонков, Д.П. Иванов, В.И. Ильин, Н.А. Кирнева, Г.С. Кирнев, Д.А. Кислов, Г.П. Костин, В.А. Кочин, Б.В. Кутеев , В.М. Леонов, В.Э. Лукаш, С.Ю. Медведев, В.А. Михайличенко, А.В. Николаев, Г.Е. Ноткин, В.Д. Пустовитов, П.В. Саврухин, В.П. Смирнов, М.М. Соколов, В.С. Стрелков, Г.Н. Тилинин, А.С. Трубников, А.Е. Угроватов, П.П. Хвостенко, С.В. Цаун, А.Н. Чудновский. ИНЖЕНЕРНО-ФИЗИЧЕСКОЕ ОБОСНОВАНИЕ РЕКОНСТРУКЦИИ ТОКАМАКА Т-15 // Вопросы атомной науки и техники. Сер. Термоядерный синтез, 2008, вып. 3, с. 3—15.
2. М.С. Лурье, О.М. Лурье Имитационное моделирование схем преобразовательной техники // Красноярск: СибГТУ. 2007 г. 145 с.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/CV-Khairutdinov.docx) [↑](#footnote-ref-1)