Contribution ID: **46**

Type: **Poster**

Study on stability of high temperature superconducting magnet in fusion reactor under nuclear heat condition

Wednesday 12 June 2024 10:40 (20 minutes)

China Fusion Experimental Reactor (CFETR), European Fusion Reactor (EU DEMO), and US Fusion Reactor (SPARC) are all actively developing high-temperature superconducting magnet (HTS) design schemes to effectively improve the magnetic field strength of future fusion reactors and increase fusion power. The resulting fusion nuclear heat effect brings great challenges to the stability of superconducting magnets. Taking CFETR as an example, the nuclear heat of toroidal field magnets caused by fusion neutrons on the side facing the plasma reaches 122.74 W·m-2. Therefore, it is particularly important to evaluate the critical characteristics of HTS in nuclear heat conditions efficiently and accurately, and to ensure its sufficient stability margin.

Burning Plasma Experimental Superconducting Tokamak (BEST) is a new type of tokamak device developed in China for the realization of deuterium-tritium fusion. In response to the nuclear heat stability of the BEST superconducting magnet system, the project team has carried out a series of research. The critical properties of high-temperature superconducting magnets are affected by factors such as temperature, magnetic field, and strain. First, based on electromagnetic analysis, the magnetic field distribution of the conductor is obtained. Then, based on Monte Carlo particle transport calculations, the nuclear heat distribution of the magnet system is obtained. Finally, based on cooling design, thermal engineering analysis is carried out. For various operating modes of BEST (induction operating mode, hybrid operating mode, and steady-state operating mode), a multi-heat source loading program is developed to achieve the segmented loading of conductor thermal load over space-time. At the same time, for the problem of temperature margin analysis under unsteady heat transfer, the magnetic field distribution and thermal load spatial distribution are coupled to realize dynamic temperature margin calculation of the conductor. The results show that the temperature margin of the high-temperature superconducting conductor is greater than 10.1K.

Topic

Innovative methods and tools for modelling large-scale HTS systems

Primary author: ZHENG, Jinxing (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences)

Co-authors: Mr LIU, Fei (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences); Mr LIU, Xufeng (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences); Mr LU, Yudong (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences)

Presenter: ZHENG, Jinxing (Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences)

Session Classification: Poster Session