CSMC POWER SUPPLY SYSTEM COMPLETES DC 48KA STEADY STATE OUTPUT EXPERIMENT

[1]Li Jiang, [1]Hong Lei, [1]Ge Gao, [1]Qiangjian Chen, [1]Linsen Wang, [1]Hua Li, [1]Zhiquan Song, [1]Liuwei Xu

[1]Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei, China

Email: redlei@ipp.ac.cn, gg@ipp.ac.cn

1. INTRODUCTION

The Central Solenoid Model Coil (CSMC) is one of the key components of the main system of the future fusion reactor, which undertakes the important task of confining high temperature plasma and creating the necessary conditions for nuclear fusion reaction. The CSMC power supply system is the key system to control the magnitude and direction of the current in the central solenoid coil. As one of the key components of the CSMC test system, the CSMC power supply system must have extremely high reliability, be able to maintain stable operation during long-term operation, and avoid power interruption or device damage caused by failures. This requires each component in the power supply system to have good quality and reliability, as well as redundant design and fault diagnosis and protection functions. Many researchers all over the world have done a lot of research work in the design, modeling, simulation and experiment of CS power supply [1-6].

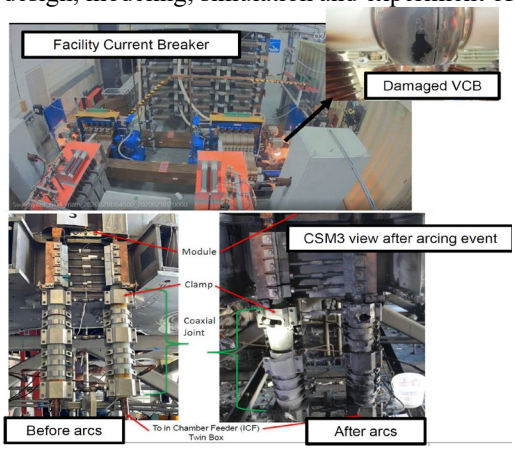

Figure 1 ITER CSMC Power Supply System

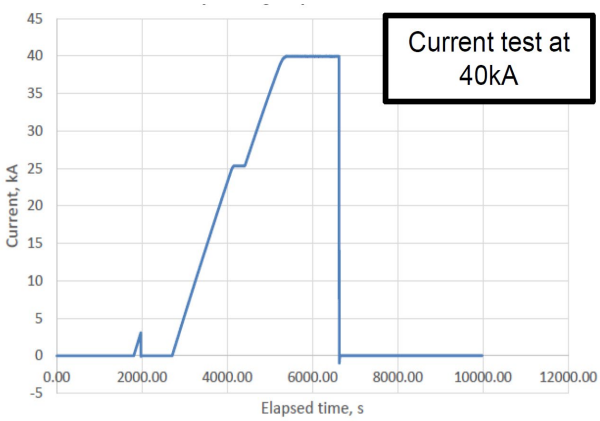

Figure 2 ITER CSMC Test Current Waveform

The development of high-power superconducting magnet power supply has always been an important topic in magnetic confinement fusion research, and the CSMC power supply system has always been a hot topic in international research. The switch damage and power supply damage occurred in the discharge process of 10 kA and 15 kA during the test of CSM in ITER. Figure 1, the highest test current reached 40 kA, as shown in Figure 2 [7]. The research team completed the development of CSMC power supply system, and successfully completed the 48kA steady-state test task in the 369mH superconducting pure inductance load test.

2. CSMC POWER SUPPLY SYSTEM AND EXPERIMENT RESULTS

The main equipment of CRAFT magnet power supply includes the equipment at the DC side and the equipment at the AC side. The DC side includes: rectifier, reactor, superconducting load, quench protection system and other equipment; the AC side includes: AC bus, rectifier transformer, switch cabinet and other equipment; the topological structure diagram of electrical equipment is shown in the Figure 3.

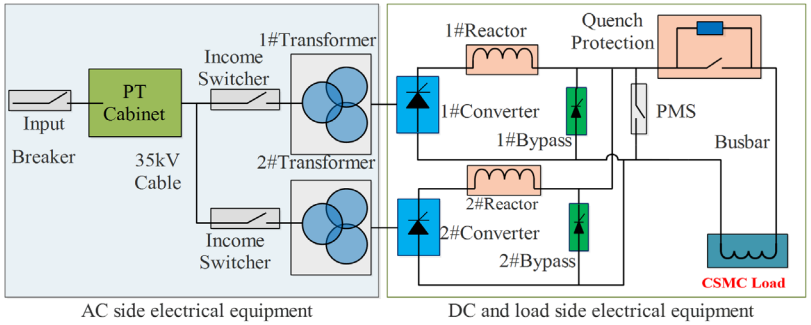

Figure 3 Topological Diagram of Electrical Equipment

A series of problems of power supply and switch have been solved after nearly one year's field installation and equipment debugging. Considering the safety of the super-large inductance magnet, the current rises in a three-stage ladder way. First, the current rises to 25 kA at a rate of 80 A/s and maintains for 8 minutes, and then the current rises to 35 kA at a rate of 80 A/s and maintains for 8 minutes. Then, the current is increased to 48kA at a rate of 80A/s and maintained for 8 minutes. Finally, the current is reduced to 0 at a rate of 80 A/s to complete the discharge [8-9].

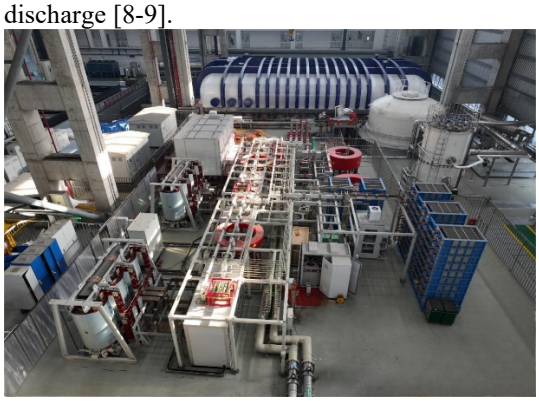

Figure 4 CSMC Power System Site Layout

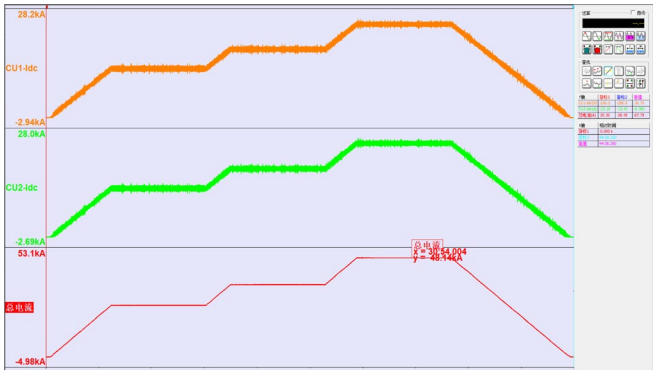

Figure 5. 48 Ka True Load Current Waveform

3. CONCLUSION

The research team completed the 48ka discharge experiment of the international largest superconducting magnet dynamic test facility power supply system (CSMC power supply), which realized the stable operation of dual power supply master-slave control and dual PID regulation working mode under large inductance load, and provided a reliable power supply design scheme and control model reference for TF magnet test power supply. The feasibility and reliability of the design scheme of the power supply system are well verified.

ACKNOWLEDGEMENTS

This work was supported by the Open Fund of Magnetic Confinement Fusion Laboratory of Anhui Province (No. 2024AMF04003), Natural Science Foundation of Anhui Province (No.228085ME142) and Comprehensive Research Facility for Fusion Technology (No. 20180000527301001228).

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