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Sat-Mo-Po.04-05: Research on key technologies of quench detection for CFETR TF prototype coil

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The design and development of quench detection for the CFETR TF prototype coil is in progress, which is expected to be completed in the fourth quarter of 2025. According to the quench simulation analysis, the voltage detection with a threshold of 200 mV and a delay of 2 s satisfies the quench detection design criteria, that is, the hotspot temperature is less than 150 K. The foundation of a successful quench detection system, of course, is the reliable measurement of the original high voltage signals, high precision suppression of inductive voltage noises, and accurate execution of quench discrimination. Key technologies include many different things such as optimal design of installation schemes for co-wound tape (CWT) and co-wound wire (CWW), automatic wrapping of CWT, welding and extraction of high voltage taps, transfer of high voltage wires and cables, high resolution data acquisition and sensitive quench discrimination mechanism. The optimization design scheme for compensation circuit and the key processes for high voltage measurement have been developed successfully to manufacture the low field sub-coils of CFETR TF prototype coil, and the test results meet the design requirements. In addition, a quench discrimination mechanism based on the varying trend of voltage has been also developed to avoid delays caused by timer reset and improve the sensitivity of quench detection. These technologies can not only further improve the reliability of CFETR TF prototype coil quench detection, but also provide robust assurance for the secure and stable operation of ITER and future full superconducting fusion reactors.

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