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Wed-Af-Po.12-07: Design of High Voltage Power Supply Grounding Protection System for Upgrading Pulsed High Magnetic Field Facility in WHMFC

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The high voltage power supply system of the pulsed high magnetic field facility at Wuhan National High Magnetic Field Center (WHMFC) will be upgraded to 167 MJ capacitor banks with 73 modules for 27 magnet experimental stations in 5 years. The capacitor bank power supply system and all magnet experimental stations are located on the second and first floors of the same building (Pulsed Building), respectively, and each floor covering an area of approximately 2000 square meters. The 27 experimental stations are divided into 4 independent zones, each equipped with different capacitor power modules and independent grounding system. This ensures that operators in other zones are not affected by high-voltage and high magnetic field experiments in a certain zone and only need to evacuate from the experimental stations in the same zone. This can improve the experimental efficiency of the facility and greatly enhance its utilization.

In this paper, a grounding protection system for the Pulse Building was designed. Ionic grounding electrodes were installed in deep underground wells outside the building, and the outdoor grounding electrodes were connected to the grounding box at the junction of the 2nd floor power hall and the 1st floor magnet experimental stations of the Pulse Building through cables. There are a total of 6 independent deep well ion grounding systems with grounding resistance less than or equal to 0.5 Ω, including 4 high-voltage experimental station zones, 1 low-voltage experimental zone, and 1 backup zone. Six independent deep well ion grounding systems are also connected to the steel bars of the building through cables from the outdoor grounding electrode, forming a unified grounding body for the entire Pulse Building.

A pulse magnetic field fault testing platform and simulation model have been established, including high-voltage power supply, magnet, low-temperature and scientific experiment systems. Simulation studies have been carried out on various serious system faults, including magnet explosion damage and high-voltage power supply short circuit. The waveforms of overvoltage and overcurrent and their transmission paths within and between experimental stations have been analyzed. Isolation transformers and SPD surge protectors have been installed on the low-voltage distribution system and equipotential connections in the experimental station to isolate high voltage and discharge short-circuit currents. Preliminary test results indicate that the designed independent grounding protection system can achieve high-voltage isolation between experimental stations, ensure the safety of equipment and personnel, and meet the requirements for reliable and efficient operation of the upgraded pulsed high magnetic field facility.

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