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The research on the design method and pre-arcing characteristic of the pulsed discharge fuse

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In the capacitive pulsed power supply, several or even hundreds of capacitors are in parallel to provide energy. If internal short circuit occurs in one of the capacitors, the others will inject a lot of energy into the fault one, which may cause a severe accident. By taking a shunt capacitor bank composed of ninety-six 33kJ-capacitors as the research object, a scheme which tries to protect shunt capacitors through current limiting fuse is evaluated. The paper describes the fusing process and puts forward a design method of pulsed discharge fuses' sectional area. A multi-field coupled model of circuit, current, structural heat transfer is developed by using COMSOL. The model is used to analyze the pre-arcing time, temperature distribution and resistance of the fuse. Due to the extremely short pulse width (about 200 μ s) of pulse current, the fusing process is assumed as an adiabatic process. The latent heat of fusion and resistivity-temperature relationship are also taken into account in the model. When the fuse isn't added to the circuit, the short-circuit discharge current peak value can reach 300kA. After adding fuse to the circuit, the simulation results show that the fuse starts to evaporate in 99 μ s when the voltage decreases from 10.8kV to 8.9kV, and the current value is 193kA at this moment. At last, a pulse circuit is constructed to verify the above results. The tests show that the fuse cuts off the current in 95 μ s, and the capacitor voltage, current is respectively 7.9kV, 200kA at this moment.

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