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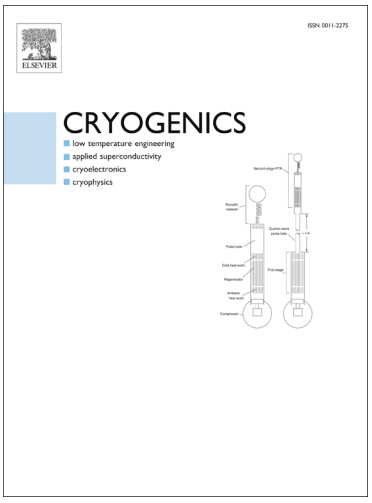

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Analysis of a Flux-Coupling Type Superconductor Fault Current Limiter with pancake coils

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The characteristics of a flux-coupling type superconductor fault current limiter (SFCL) with pancake coils are investigated in this paper. The conventional double-wound non-inductive pancake coil used in AC power systems has an inevitable defect in Voltage Sourced Converter Based High Voltage DC (VSC-HVDC) power systems. Due to its special structure, flashover would occur easily during the fault in high voltage environment. Considering the shortcomings of conventional resistive SFCLs with non-inductive coils, a novel flux-coupling type SFCL with pancake coils is carried out. The module connections of pancake coils are performed. The electromagnetic field and force analysis of the module are contrasted under different parameters. To ensure proper operation of the module, the impedance of the module under representative operating conditions is calculated. Finally, the feasibility of the flux-coupling type SFCL in VSC-HVDC power systems is discussed.

Key words: Superconducting fault current limiter, YBCO, electromagnetic coupling condition, force analysis, impedance calculation.

1. INTRODUCTION

VSC-HVDC power systems are being developed to meet increasing electricity demands [1,2,3] . For VSC-HVDC power systems, one of the major challenges is how to manage fault currents. In the case where the fast HVDC circuit breakers lack the capacity to match the fault current level in the VSC-HVDC power systems, SFCLs are used to make the shut off easier for the circuit breakers [4,5]. SFCLs can reduce not only the fault current level but also the increasing rate of the fault current so that the fast HVDC circuit breakers can work effectively [6,7,8].

The resistive SFCL is widely concerned as it has a simple topology and no on-state loss. In fact, the resistive SFCL is already demonstrated in the low voltage power systems [9]. Among all kinds of the resistive SFCLs [10-15], the SFCL with pancake coils is more compact than those using solenoid coils. That means the space of the SFCL and the refrigeration system could be much smaller. However, the conventional resistive SFCL with pancake coils is not suitable for high voltage power systems because of the weakness of insulation. In an AC environment, as breaking time of the circuit breaker is about 50ms, the impulse current could reach

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