Contribution ID: **706** Contribution code: **THU-PO3-512-05** Type: **Poster**

Comparison and analysis of inductance according to toroidal winding type of superconducting element combined the DC circuit breaker

Thursday, 18 November 2021 10:00 (20 minutes)

DC Interruption technology is essentially required as DC system and microgrid have increased. The Interruption technology also includes current-limiting technology, and it is suppressed the fault current that rises when the fault current occured. Until now, many hybrid Interruption technologies have been proposed in which a semiconductor element or a superconducting element is combined with a mechanical DC circuit breaker. In this paper, a superconducting element was used combined the DC circuit breaker. The advantage of a circuit breaker using a superconducting element is that no loss occurs and the faster more than the semiconductor device. When the fault current in the main line, a quench phenomenon of the superconducting element causes due to critical current and temperature of superconductor. The fault current is limited by the resistance generated during quenching and the fault current vibrates due to the LC divergence ocillation circuit. When the zero-point is generated by vibration, it is cut-off the fault current with a mechanical switching. Superconducting element are simple structure. And it exhibits different characteristics depending on its shape, material, and length. The purpose of this study is to maximize the efficiency of the superconducting element by changing the winding shape, material and length. Solenoid and toroidal windings set up that the same number of turns, pitch interval, thickness and width were modeled using the Maxwell 3D simulation program. As a result of the simulation, the toroidal winding generated more inductance than the solenoid winding. Also, we combined the superconducting element and the mechanical DC circuit breaker and analyze the characteristics of cutoff operating in transient state. As a result, the toroidal winding had a slower generated than the solenoid winding. In addition, the toroidal type had the higher the limiting rate of the fault current due to the relatively large impedance.

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Session Classification: THU-PO3-512 SFCL