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Analysis of cut-off characteristics of transformer-type superconducting DC circuit breaker according to reactance of superconductor and transformer turns ratio.

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The DC fault current does not naturally generate zero-point, so it generates a large arc when cut-off operation. If it is failure to quickly extinguish the arc generated at the moment, lead to fire and equipment damage. Therefore, we proposed a fast and reliable transformer-type superconducting DC circuit breaker. The transformer-type superconducting current limiting elements are highly and likely to be put into practical use due to their high fault current limiting rate and high technology. Transformer-type superconducting DC circuit breaker consists of a current limiting part and a cut-off part. In the current limiting part is a transformer structure, and the primary line is composed of a copper coil, and the secondary line is composed of a copper coil and a superconducting coil. In the cut-off part, a mechanical DC circuit breaker, an LC divergence vibration circuit, and a lightning arrester are connected in parallel. When an accident occurs, the superconducting current-limiting element changes to a normal conduction state due to the secondary current of the transformer and generates impedance. Therefore, the secondary current is limited, and amount of magnetic flux change occurring is related to primary coil(main line), thus the fault current of the main line is limited. Also, the mechanical DC circuit breaker cuts off the direct current by occurring an artificial zero point on the fault current.

In this paper, a DC simulation circuit was designed using the PSCAD/EMTDC, and the cut-off characteristics were analyzed by applying a transformer-type superconducting DC circuit breaker. As a result, the fault current and cut-off time decreased to about 60.89 % and 45.79 ms due to the influence superconducting element of the transformer-type DC circuit breaker in the transients. Additionally, there are the limiting of the maximum fault current was effectively appeared as the ratio of the transformer's turns decreases.

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