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Wed-Mo-Po3.08-06 [58]: Conceptual design of a saturated iron core superconducting fault current limiter for a DC power system

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Recently, high voltage direct current (HVDC) power systems have been widely developed and used around the world because of their large transmission capacity and low power loss. However, conventional DC circuit breaker (DCCB) is difficult to interrupt large fault current. Therefore, to limit the fault current to a relatively low level, a superconducting fault current limiter (SFCL) is introduced to effectively and rapidly limit the fault current due to inherent physical properties of the superconductor and significantly reduce the stress on the DCCB of the HVDC system. This paper presents a conceptual design of a saturated iron core SFCL (SI-SFCL) for a 15 kV, 3 kA DC power system. First, the electrical characteristics of the SI-SFCL were analyzed and the relationship between the fault current and the SI-SFCL parameters was defined. Then, the detailed design process of the SI-SFCL and its corresponding configuration were summarized. A mathematical model was developed to investigate the fault characteristics of the 15 kV, 3 kA DC power system and to determine the parameters of SI-SFCL accordingly. We also implemented the PSCAD/EMTDC simulation to analyze the operation and fault current limiting characteristics of the SI-SFCL. The validity of the fault current limiting performance and the design parameters was verified through the simulation results. When a fault occurred, the iron core was no longer saturated and the inductance of the SI-SFCL was increased due to the increase of permeability. As a result, the inductance of the SI-SFCL became much larger than that of the normal operating state for a very short time during the fault, limiting the fault current up to 70%. Since the SI-SFCL was not quenched, the system was immediately recovered by reclosing of the DCCB. The results of this study will be effectively applied to the development of SI-SFCL for large-scale HVDC power systems.

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