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Simulation of the transient overvoltage in HVDC scheme during the operation of MRTB

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During the transfer from monopolar ground return mode of HVDC to monopolar metallic return mode, Metallic Return Transfer Breaker (MRTB) will cut a large current and induce transient overvoltage on dc output and converter transformer. It is challenging to simulate this electromagnetic transient, because the arc procedure of MRTB is usually ignored in traditional simulation. In this paper, a simulation model of a±800 kV HVDC scheme is established in PSCAD to investigate the transient procedure. The MRTB is simulated with three branches, including SF6 breaker branch, arrester branch, and a series branch of a reactor and a capacitor. When the MRTB start to open the ground return circuit, an arc initials at the fracture of the breaker. Nonlinear resistance of the arc forms a resonant loop with the reactor and the capacitor, and the resonant current will cross zero and create a break condition for the breaker. The dynamic resistance model of the arc generated in MRTB is built based on Mayr's arc model. The MRTB model is able to simulate the dynamic performance of the switch operation procedure, and then is applied to analyze the overvoltage in the HVDC scheme. Once the resonant current is suddenly cut off, the energy stored in the reactor will be transferred to the capacitor and then absorbed by the arrester. Thus, the voltage on the MRTB increased abruptly and then decreased slowly. The highest voltage appeared on the MRTB is over 100 kV. Besides, the overvoltage at inverter side is over 1.1 p.u. The DC bias voltage from the converter side windings to the earth also varies with the operation of the MRTB, but the winding voltage remains unchanged.

Primary author: Dr ZHU, Lingyu (Xi'an Jiaotong University)

Co-authors: Ms SONG, Ying (Xi'an Jiaotong University); Mr ZHAO, Zheng (State Power Economic Research Institute)

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