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Simulation study of switching over-voltage of UHVDC transmission system under hierarchical connection mode caused by typical faults

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UHVDC transmission system with hierarchical connection mode is a new trend. In this mode, the inverter station adopts the way of layered access to 1000 kV and 500 kV AC power grid, which can realize the optimization of UHVDC power transmission, improve the voltage support ability of the receiving end AC system and guide the reasonable distribution of power flow.

Insulation coordination is a fundamental problem to be solved when building UHVDC transmission system. The requirement is to achieve an acceptable insulation failure rate with minimal insulation investment. The key issue is to determine the voltage level taken during the withstand voltage test of the insulation structure. Thus it is necessary to study the generation and distribution of over-voltage of UHVDC transmission system with hierarchical connection mode.

In this paper, an electronic transient model of ultra-high voltage DC transmission system with hierarchical connection mode is set up by EMTDC/PSCAD simulation software based on ±1100 kV Zhundong-East China project. Basing on the simulation platform, this paper studies the mechanism and distribution of switching over-voltage caused by typical faults, such as grounding fault of AC bus, opening fault of neutral line and opening fault of metallic return line. The over-voltage suppression measures are proposed for protection start delay and fast ground switch operation delay according to the simulation results obtained. The research results provides a method of optimizing the configuration of arresters. The conclusions of this paper can be applied for the insulation coordination and fault analysis of the following UHVDC transmission project with hierarchical connection mode.

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