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特高压输电

特高压直流输电系统换流站内部故障电磁暂态响应特性及控制策略

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摘要:

以云广 ±800 kV直流输电系统为例，基于PSCAD/ EMTDC搭建仿真模型，研究换流站内部阀误开通和不开通2种故障工况，仿真分析整流站和逆变站内部分别发生阀误开通和不开通故障的情况，并对故障引起的系统电磁暂态过程及相应的控制系统策略进行了深入研究。得出以下结论：1）逆变阀发生误开通故障时，会引起换相失败，同时在极线上会出现过电流。但由于一般不会连续发生误开通故障，因而不会出现振荡过电流和过电压；2）整流阀发生误开通故障的可能性比较小，即使开通也仅是提前开通，因此对直流系统的影响比较小；3）逆变侧发生连续不开通故障比整流侧发生连续不开通故障所引起的直流电流振荡幅值大，同时引起的中性线过电压及对负极的影响也大；4）双极运行时，一极发生连续不开通或发生单次误开通，会对另一极运行有影响，引起较小波动。但是该健全极仍可运行，传输一半的功率；5）当故障引起直流电流、电压较大振荡时，整流侧控制系统通过定电流控制与a min之间的切换来实现系统快速恢复，逆变侧则通过定关断角控制和定电流控制之间的相互切换，使系统快速恢复正常。

关键词:

Electromagnetic Transient Response Characteristics of Internal Faults in UHVDC Converter Station and Corresponding Control Strategy

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Abstract:

Taking ±800 kV DC power transmission project from Yunnan to Guangdong for example, based on PSCAD/ EMTDC a simulation model is built to research operation modes of converter station under internal faults of mis-conducting and non-conducting, and simulate the conditions that mis-conducting and non-conducting faults occur inside rectifier station and converter station respectively, and the electromagnetic transient process of DC transmission system and corresponding control strategies are research in depth. Research results are as following: the mis-conduction of inverter will cause commutation failure, however, because in general the mis-conducting fault will not recur, so the over-voltage and over-current due to oscillation will not appear; there is less possibility of mis-conducting fault of rectifier, so its affect on DC transmission system is slight; the non- conducting fault occurred in inverter side one after another will cause higher amplitude of current oscillation than that caused by the same fault occurred in rectifier side, and the caused over-voltage of neutral line will make an evident affect on negative pole; during the bipolar operation, when single-time non-conducting of a pole occurs or non-conducting of a pole occur one after another will affect on the operation of the another pole and cause narrow fluctuation, however the transmitted power will be reduced by half; when the mis-conducting or non-conducting faults lead to stronger oscillation of DC voltage and current, at rectifier side by means of the switchings between constant current control and minimum a min the system can be quickly recovered, and at inverter side by means of the switchings between constant extinguish angle the system can be returned to normal condition.

Keywords:

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参考文献：

[1] 赵畹君．葛洲坝—上海直流输电工程的稳态运行特性[J]．电网技术，1989，13(3)：11-19． Zhao Wanjun．The steady state characteristics of Gezhouba-Shanghai HVDC project[J]．Power System Technology，1989，13(3)：11-19(in Chinese)． [2] 石岩，韩伟，张民，等．特高压直流输电工程控制保护系统的初步方案[J]．电网技术，2007，31(2)：11-15． Shi Yan，Han Wei，Zhang Min，et al．A preliminary scheme for control and protection system of UHVDC project[J]．Power System Technology，2007，31(2)：11-15(in Chinese)． [3] 陶瑜，龙英，韩伟．高压直流输电控制保护技术的发展与现状[J]．高电压技术，2004，30(11)：8-10． Tao Yu，Long Ying，Han Wei．Status and development of HVDC control and protection[J]．High Voltage Engineering，2004，30(11)：8-10(in Chinese)． [4] 余占清，何金良，张波，等．高压直流换流站中换流阀传导骚扰时域仿真分析[J]．中国电机工程学报，2009，29(10)：17-23． Yu Zhanqing，He Jinliang，Zhang Bo，et al．Time-domain simulation of conducted EMD caused by HVDC valves in substations[J]．Proceedings of the CSEE，2009，29(10)：17-23(in Chinese)． [5] Thio C V，Davies J B，Kent K L．Commutation failures in HVDC transmission systems [J]．IEEE Trans on Power Delivery，1996，11(2)：946-957． [6] 荆勇，欧开健，任震．交流单相故障对高压直流输电换相失败的影响[J]．高电压技术，2004，30(3)：60-62． Jing Yong，Ou Kaijian，Ren Zhen．Analysis on influence of AC single phase faults on HVDC commutation failure[J]．High Voltage Engineering，2004，30(3)：60-62(in Chinese)． [7] Kristmundsson G M，Carroll D P．The effect of AC system frequency spectrum on commutation failure in HVDC inverters[J]．IEEE Trans on Power Delivery，1990，5(2)：1121-1128． [8] 何朝荣，李兴源，金小明，等．高压直流输电系统换相失败判断标准的仿真分析[J]．电网技术，2007，31(1)：20-24． He Chaorong，Li Xingyuan，Jin Xiaoming，et al．Simulation analysis on commutation failure criteria for HVDC transmission systems[J]．Power System Technology，2007，31(1)：20-24(in Chinese)． [9] 任景，李兴源，金小明，等．多馈入高压直流输电系统中逆变站滤波器投切引起的换相失败仿真研究[J]．电网技术，2008，32(12)：17-22． Ren Jing，Li Xingyuan，Jin Xiaoming，et al．Simulation study on commutation failure caused by switching AC filters of inverter stations in multi-infeed HVDC system[J]．Power System Technology，2008，32(12)：17-22 (in Chinese)． [10] 西南电力设计院．云广直流输变电工程换流站主回路参数计算暨设备选型设计(检索号：50—X224-A0401)[R]． [11] 赵良，李蓓，卜广全，等．云南—广东 ±800 kV直流输电系统动态等值研究[J]．电网技术，2006，30(16)：6-10． Zhao Liang，Li Bei，Bu Guangquan，et al．Study on dynamic equivalence of ±800 kV DC transmission system from Yunnan to Guangdong[J]．Power System Technology，2006，30(16)：6-10(in Chinese)． [12] Szechtman M，Wess T，Thio C V．First benchmark model for HVDC control studies[J]．Electra，1991，135：54-67． [13] Szechtman M，Wess T，Thio C V．A benchmark model for HVDC system studies[C]．International Conference on AC/DC Power Transmission，1991，135：374-378． [14] 朱艺颖，蒋卫平，吴雅妮．特高压直流输电控制保护特性对内过电压的影响[J]．电网技术，2008，32(8)：6-9． Zhu Yiying，Jiang Weiping，Wu Yani．Influence of UHVDC control and protection characteristics on inner overvoltage[J]．Power System Technology，2008，32(8)：6-9(in Chinese)． [15] Faruque M O，Zhang Yuyan，Dinavahi V．Detailed modeling of CIGRé HVDC benchmark system using PSCAD/EMTDC and PSB/SIMULINK[J]．IEEE Transactions on Power Delivery，2006，21(1)：378-387． [16] Sood V K，Khatri V，Jin H．EMTP modeling of CIGRE benchmark based HVDC transmission system operating with weak AC system [C]．International Conference on Power Electronics，1996，8(1)：426-432．

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