

国家重点基础研究项目

基于调制理论的换流变压器铁心饱和和不稳定分析

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摘要:

阐述了电流开关函数的详细推导过程, 简要介绍了变压器铁心饱和和不稳定的产生机理, 首次把调制理论应用于解决换流变压器铁心饱和和不稳定问题, 并提出了一种判断此种谐波不稳定的新方法, 然后基于南方电网2010年数据, 采用PSCAD/EMTDC建立了云广±800 kV直流输电系统详细电磁暂态的仿真模型, 对三相接地故障激发的铁心饱和和不稳定现象进行了仿真试验, 验证了该新方法的正确性。

关键词: 调制理论 电流开关函数 铁心饱和和不稳定

Modulation Theory Based Analysis on Converter Transformer Core Saturation Instability

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Abstract:

Due to its intuition, clear physical conception and convenient to use, in the calculation of harmonics of power system more and more attentions are paid to modulation theory. In this paper the detailed derivation of current switching function is expounded, and the mechanism causing transformer core saturation instability is presented briefly. It is the first time to apply modulation theory to solve converter transformer core saturation instability and a new method to judge such a harmonic instability is proposed; then based on the data of China Southern Power Grid in 2010 and by use of PSCAD/EMTDC, a simulation model for detailed electromagnetic transient of ±800 kV DC power transmission system from Yunnan to Guangdong is built, and using the built model the simulation research on core saturation instability caused by three-phase grounding fault is performed. Simulation results verify the correctness of the proposed method.

Keywords: modulation theory current switching function core saturation instability

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参考文献:

[1] 李兴源. 高压直流输电系统的运行和控制[M]. 北京: 科学出版社, 1998: 44-52. [2] 郝巍, 李兴源, 金小明, 等. 直流输电引起的谐波不稳定及其相关问题[J]. 电力系统自动化, 2006, 30(19): 94-99. Hao Wei, Li Xingyuan, Jin Xiaoming, et al. A survey of harmonic instability and related problem caused

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by HVDC[J]. Automation of Electric Power Systems, 2006, 30(19): 94-99(in Chinese). [3] 谷毅, 赵玉柱, 张国威. 关于500 kV东明开关站启动调试期间发生电压谐振的分析[J]. 电网技术, 2002, 26(12): 71-74. Gu Yi, Zhao Yuzhu, Zhang Guowei. Discussion on voltage resonance occurred in Bao-ren 500 kV transmission line during start up of Dongming switching station[J]. Power System Technology, 2002, 26(12): 71-74(in Chinese). [4] 毛晓明, 吴小晨. 南方交直流并联电网运行问题分析[J]. 电网技术, 2004, 28(2): 6-13. Mao Xiaoming, Wu Xiaochen. Analysis on operational problems in south China AC-DC hybrid power grid[J]. Power System Technology, 2004, 28(2): 6-13(in Chinese). [5] 袁清云. 特高压直流输电技术现状及在我国的应用前景[J]. 电网技术, 2005, 29(14): 1-3. Yuan Qingyun. Present state and application prospect of ultra HVDC transmission in China[J]. Power System Technology, 2005, 29(14): 1-3(in Chinese). [6] Hu Lihua, Yacamini R. Harmonic transfer through converters and HVDC links[J]. IEEE Transactions on Power Electronics, 1992, 7(3): 514-525. [7] Hu L, Yacamini R. Calculation of harmonics and interharmonics in HVDC schemes with low DC side impedance[J]. IEE Proceedings-C, 1993, 140(6): 469-476. [8] Hu Lihua, Yacamini R. Calculation of harmonic interference in HVDC systems with unbalance[C]. IEE Fourth International Conference on AC and DC Power Transmission, 1991: 390-394. [9] Hu Lihua, Morrison R E. The use of modulation theory to calculate the harmonic distortion in HVDC systems operating on an unbalanced supply[J]. IEEE Transactions on Power Systems, 1997, 12(2): 973-979. [10] Ying Jiang, Ake E. General analysis of harmonic transfer through converters[J]. IEEE Trans on Power Electronics, 1997, 12(2): 287-293. [11] Carbone R, Rosa F D, Langella R. A new approach to model AC/DC/AC conversion systems[C]. IEEE Power Engineering Society Summer Meeting, 2001. [12] Yu Tao, Shi Dan, Ren Zhen, et al. Study on modeling of multi-harmonic sources in AC/DC hybrid transmission system [C]. IEEE/PES Transmission and Distribution Conference & Exhibition, Dalian, China, 2005. [13] Burton R S, Prediction of core saturation instability at an HVDC converter[J]. IEEE Trans on Power Delivery, 1996, 11(4): 1961-1969. [14] Ainsworth J D. Core saturation instability in Kingsnorth HVDC link [C]. CIGRE Study Committee 14, Winnipeg, Canada, 1977. [15] Chen S, Wood A R, Arrillaga J. HVDC converter transformer core saturation instability: a frequency domain analysis[J]. IEE Proceedings of Generation, Transmission and Distribution, 1996, 143(1): 75-81. [16] Rashid M H, Maswood A I. Analysis of three phase AC/DC converters under unbalanced supply conditions[J]. IEEE Trans on Industrial Applications, 1988, 24(3): 449-455. [17] 杨小兵, 李兴源, 金小明, 等. 云广特高压直流输电系统中换流变压器铁心饱和和不稳定分析[J]. 电网技术, 2008, 32(19): 5-9. Yang Xiaobing, Li Xingyuan, Jin Xiaoming, et al. Analysis on converter transformer core saturation instability in UHVDC power transmission system from Yunnan to Guangdong[J]. Power System Technology, 2008, 32(19): 5-9(in Chinese). [18] 穆子龙, 李兴源, 金小明, 等. 云广特高压直流输电系统中换流变压器铁心饱和和不稳定分析[J]. 电网技术, 2008, 32(20): 8-14. Mu Zilong, Li Xingyuan, Jin Xiaoming, et al. Research on harmonic instability problem at sending end of UHVDC power transmission project from Yunnan to Guangdong[J]. Power System Technology, 2008, 32(20): 8-14(in Chinese).

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2. 杨小兵 李兴源 金小明 郝巍.云广特高压直流输电系统中换流变压器铁心饱和和不稳定的抑制[J]. 电网技术, 2009,33(19): 32-36