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Modeling and analysis on the six-phase generator - converter system as the magnetic field power supply of HL-2A/M

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The flywheel six-phase generator operated in pulse mode supply power of the magnetic field on HL-2M tokamak. The precise and stable control of six-phase generator is essential for obtaining high beta, steady state plasmas in HL-2M.

Concretely for the power supply of the toroidal field coils on HL-2A, it consists of six-phase synchronous generators with their excitation systems, diode rectifiers, and the toroidal field coils. The diode rectifiers connect the terminals of the generators from AC side, and the toroidal field coils from DC side. During a shot of plasma discharge, the energy stored mechanically in the shafting of generator is transferred to the toroidal field coils by firing the exciter of the six-phase synchronous generator. In this case, modeling on the six-phase synchronous generator operated in pulse mode is the one of key issues for the precise and stable control.

The state space realization of the six-phase generator with related exciters is specifically developed by dual DQ transformation. Based on the electromagnetic dynamics which describes the flux linkage changes in DQ frame, the six-phase generator is represented by exciting voltage controlled current source. On the other hand, the electromagnetic torque is calculated from the interaction between the flux linkages and currents in DQ frame, this torque drives the shafting speed to decrease from the initial speed, i.e., the energy is released.

The dynamics of the toroidal field current scenario is simulated on the basis of state space realization of six-phase generator built in DQ frame. The results show the consistency with the experimental results of HL-2A, and the realization is effective for the toroidal field current control. Furthermore, this model can be adopted for the preprogrammed feedback control of power supplies on HL-2M. Moreover, it is also suited for the simulation and analysis of synchronous machine - converter systems.

Eligible for student paper award?

No

Authors: Dr LIU, Xiaolong (Southwestern Institute of Physics, Chengdu, China); Prof. XUAN, Weimin (Southwestern Institute of Physics, Chengdu, China); Prof. YAO, Lieying (Southwestern Institute of Physics, Chengdu, China); Dr WANG, Yingqiao (Southwestern Institute of Physics, Chengdu, China); Dr PENG, Jianfei (Southwestern Institute of Physics, Chengdu, China); Prof. LI, Huajun (Southwestern Institute of Physics, Chengdu, China); Ms WANG, Yali (Southwestern Institute of Physics, Chengdu, China); Mr BU, Mingnan (Southwestern Institute of Physics, Chengdu, China)

Presenter: Dr LIU, Xiaolong (Southwestern Institute of Physics, Chengdu, China)

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