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Wed-Af-Po.12-05: Research of 0°/-180° phase-shift asymmetric firing converters for steady-state magnet power supplies

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Converters composed of thyristor full bridges are commonly used to feed superconducting coils and test magnets. Since magnets mostly operate in the steady state, converters under symmetric firing generate significant reactive power. In this paper, a design of the 0°/-180°phase-shift converter is proposed with asymmetric firing to reduce fundamental reactive power, and the even harmonics cancelling are further explained. Then, the sufficient voltage output capability is introduced in terms of available firing angle selections. As for operation issues, firstly, steady ripple calculations provide a reference for selecting DC reactors and firing angles. Secondly, while symmetric firing is still used during pre-excitation and demagnetization, the switch logic from symmetric to asymmetric firing is designed to avoid commutation failures and estimate the perturbation to current balance of bridges. Furhter analysis indicates that transient unbalanced volt-seconds remain constant despite firing angle changes. Thirdly, a current-sharing control method that meets both reliable commutation and the minimization of even harmonics is proposed. Finally, the converter design and characteristics are verified by simulations using the parameters of CSMC converters.

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