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P4.092 The reactive power demand in DEMO: estimations and mitigation strategies

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The European DEMO, which will follow ITER according to the Roadmap of the European fusion program, is presently under Pre-Conceptual Design. The DEMO Plant Electrical System (PES) will include the Power Supply (PS) and the Electrical Power Generation systems. In all the present tokamaks, the main magnets, which constitute the major loads, are powered by thyristor rectifiers; in DEMO they should be rated for several tens of kA and about ten kV. One of the main drawback of thyristor rectifiers operation is the large reactive power consumption when low voltage values are required by the load, as occurs during the major part of the plasma pulse. To satisfy the limitations imposed by the National Grid Operator and to reduce the currents flowing in the Medium Voltage Distribution System, the reactive power has to be compensated. In ITER, this is realized with a huge Reactive Power Compensation and Harmonic Filtering system, rated for 750 MVAR in total and based on Thyristor Controlled Reactors and tuned filters. Beside its additional cost and area occupancy, the high dynamics required to satisfy the reactive power limit in transient conditions represents a further severe challenge. These problems would be much amplified in DEMO, where the power ratings of the base converters are about five times higher than those of ITER. This paper presents the analytical model developed to estimate the reactive power demand of DEMO and the results achieved, assuming the traditional solution based on thyristor converters and the usual reactive power mitigation strategies. Then, an innovative approach, based on Active Front End converters, is proposed. A possible topology is studied, the achievable performance is derived by means of numerical simulations, and the pros and cons of the two options are discussed.

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