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Dynamic Simulation on Flow Characteristics of KSTAR PF Magnet Cryogenic Network

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During its nominal operation, strong current variation, more than 10 kA per second, can be imposed on the KSTAR PF (Poloidal Field) magnet system. Due to AC loss, transient massive backward flow can occur, especially at the cryogen inlets of each magnet. To protect cryogen circulator, several valves are activated to adjust or lower pressure below the circulator's operation limit. In this work, we discuss whether currently available thermo-hydraulic code, such as SUPERMAGNET, can describe this overall dynamic flow characteristics of KSTAR PF magnet cryogenic network. First, three major functions of the KSTAR PF magnet cryogenic system during plasma operation are classified and discussed. Cryogenic components mostly related with other functions such as, cool-down process, are removed from the simulation circuit to minimize computation time as much as possible. SUPERMAGNET code was used with a slight modification in its cryogenic network simulation module, FLOWER. The codes for cryogenic valves are modified so that not only steady state but also general compressible flows can be described. A case study for an actual KSTAR plasma operation has been intensively carried out. It was shown that most relevant data, pressure, temperature and mass-flow, both at the inlets and outlets of the magnet, are in agreement with simulation results.

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