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Design of magnet and shielding systems for DEMO

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Designing magnet systems for fusion devices, including tokamaks, stellarators, and mirror machines, requires careful consideration of the intense radiation environments in which these systems operate. This study focuses on the conceptual design and optimization of magnet systems for DEMO and VNS machines, with particular attention to achieving a balance between compactness, durability, and performance, alongside effective radiation shielding. Multiple cable configurations, such as High-Temperature Superconductors (HTS) in Cable-in-Conduit and Dry-Conductor designs, are analyzed to determine optimal solutions for magnetic field strength, neutron shielding efficiency, and thermal stability. Key design considerations include coil sizing for maximum plasma confinement, management of neutron heat load and cumulative radiation dose on superconducting materials, and the implementation of shielding strategies to mitigate radiation-induced degradation. Through comparison of various design options, this work identifies configurations that enhance the operating lifetime and stability of magnet systems under high neutron flux conditions.

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