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Shield Material Consideration in the LAR Tokamak Reactor

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For the optimal design of a tokamak-type reactor, self-consistent determination of a radial build of reactor systems is important and the radial build has to be determined by considering the plasma physics and engineering constraints which inter-relate various reactor systems. In a low aspect ratio (LAR) tokamak reactor with a superconducting toroidal field (TF) coil, the shield should provide sufficient protection for the superconducting TF coil and the shield plays a key role in determining the size of a reactor. To determine the radial build of a reactor, neutronic effects such as tritium breeding in the blanket, nuclear heating, and radiation damage to toroidal field (TF) coil has to be included in the systems analysis. In this work, the outboard blanket only is considered where tritium self-sufficiency is possible by using an inboard neutron reflector instead of breeding blanket. The reflecting shield should provide not only protection for the superconducting TF coil but also improved neutron economy for the tritium breeding in outboard blanket. Tungsten carbide, metal hydride such as titanium hydride and zirconium hydride can be used for improved shielding performance and thus smaller shield thickness. With the use of advanced technology in the shield, conceptual design of a compact superconducting LAR reactor with aspect ratio of less than 2 will be presented as a viable power plant.