

# Molten salt self-cooled solid first wall and blanket design based on advanced ferritic steel

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**Abstract.** As an element in the U.S. Advanced Power Extraction (APEX) program, the solid first wall and blanket design team assessed innovative design configurations with the use of advanced nano-composite ferritic steel (AFS) as the structural material and Flibe as the tritium breeder and coolant. The goal for the assessment is to search for designs that can have high volumetric power density and surface heat-flux handling capability, with assurance of fuel self-sufficiency, high thermal efficiency and passive safety for a tokamak power reactor. We selected the re-circulating flow configuration as our reference design. Based on the material properties of AFS we found that the reference design can handle a maximum surface heat flux of 1 MW/m<sup>2</sup>, and a maximum neutron wall loading of 5.4 MW/m<sup>2</sup>, with a gross thermal efficiency of 47%, while meeting all the tritium breeding, structural design and passive safety requirements. This paper will cover the results of the following areas of assessment: material design properties, FW/blanket design configuration, materials compatibility,

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components fabrication, neutronics analysis, thermal hydraulics analysis including MHD effects, structural analysis; molten salt and helium closed cycle power conversion system; and safety and waste disposal of the re-circulating coolant first wall and blanket design.

***Keywords:*** Fusion, first-wall, blanket, advanced ferritic steel, Flibe, re-circulation coolant, systems study, liquid metal MHD, gas-turbine.