APEX ADVANCED FERRITIC STEEL, FLIBE SELF-COOLED FIRST WALL AND BLANKET DESIGN*

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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 high 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 recirculating 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^2 and a maximum neutron wall loading of 5.4 MW/m^2, with a gross thermal efficiency of 47%, while meeting all the tritium breeding and structural design requirements. This paper will cover the results of the following areas of assessment: material design properties, FW/blanket design configuration, materials compatibility, 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 aspects of the recirculating coolant design.

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* Work supported by U.S. Department of Energy Contract DE-AC03-98ER54411.