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CAREM 25 fuel cycle optimization and ATF evaluation

The use of Accident Tolerant Fuels (ATF) is evaluated from the neutronics and economics points of view as a means for enhancing reactor safety while maintaining competitiveness of the CAREM 25 nuclear fuel cycle. The ATF evaluated consists on the use of FeCrAl cladding and keeping UO₂ and Gadolinia Burnable Poison (BP) as the fuel it self. The FeCrAl cladding has the outstanding advantage of avoiding the Hydrogen production that results from Zirconium oxidation of conventional Zircaloy claddings undergoing overheating. However, the use of FeCrAl imposes a considerable increase in absorptions that has to be counter balanced with an increase in Uranium enrichment.

Particular features of SMR cores, such as their small sizes and “boron-free” designs along with a smaller amount of control rods available, impose tighter restrictions to power distribution and reactivity control. The fuel design is hence optimized from the neutronics point of view to comply with design requirements, which leads to a concentration of BPs adjusted for every enrichment chosen, while the optimum enrichment level results from an economic optimization. Therefore, results of burnable poison and enrichment optimizations, as well as their consequence in the decrease of the reactivity worth of control rods, are presented in this paper.

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