FEASIBILITY STUDY OF SELF SUSTAINING CAPABILITY ON WATER COOLED THORIUM REACTORS FOR DIFFERENT POWER REACTORS

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ABSTRACT

Thorium fuel cycle can maintain the sustainable system of the reactor for self sustaining system for future sustainable development in the world. Some characteristics of thorium cycle show some advantages in relation to higher breeding capability, higher performance of burn-up and more proliferation resistant. Several investigations was performed to improve the breeding capability which is essential for maintaining the fissile sustainability during reactor operation in thermal reactor such as Shippingport reactor and molten salt breeder reactor (MSBR) project. The preliminary study of breeding capability on water cooled thorium reactor has been investigated for various power output. The iterative calculation system is employed by coupling the equilibrium fuel cycle burn-up calculation and cell calculation of PIJ module of SRAC2000. In this calculation, 1238 fission products and 129 heavy nuclides are employed. In the cell calculation, 26 heavy metals and 66 fission products and 1 pseudo FP are employed. The employed nuclear data library was JENDL 3.2. The reactor is fueled by ^{233}U-Th Oxide and it has used the light water coolant as moderator. Some characteristics such as conversion ratio and void reactivity coefficient performances are evaluated for the systems. The moderator to fuel ratio (MFR) values and average burnups are studied for survey parameter. The parametric survey for different power outputs are employed from 10 MWt to 3000 MWt for evaluating the some characteristics of core size and leakage effects to the spectra profile, required enrichment, breeding capability, fissile inventory condition, and void reactivity coefficient. Different power outputs are employed in order to evaluate its effect to the required enrichment for criticality, breeding capability, void reactivity and fissile inventory accumulation. The obtained value of the conversion ratios is evaluated by using the equilibrium atom composition. The conversion ratio is employed based on the fertile and fissile nuclides with the contribution from intermediate nuclides such as ^{234}U and ^{233}Pa. The conversion ratio is evaluated by considering the conversion capability of the reactor to convert the fertile material into fissile material. The fissile accumulation capability for different conditions is investigated for estimating the fissile production capability during operation. The result shows the negative reactivity coefficient, and its feasibility of breeding for different MFR and burnup. The very tight lattice pin of MFR $\leq$ 0.3 is preferable for obtaining breeding condition for relatively higher burnup. The breeding capability of the reactor increases with increasing power output and decreasing power density. In relation to the self sustaining system, the large power output is easier to reach than the small power output.