ABSTRACT

Heat pipe cooled micro nuclear reactors (Heat Pipe Reactors/HPRs) are one potential solution for providing clean and sustainable energy, especially for remote areas, due to their compact, modular design and reliance on passive safety systems. One important aspect of HPR operation is the reactivity control system, which is greatly influenced by the configuration of the control rods and control drum. This study aims to analyze the effect of control rod configuration on neutron activity and power distribution in a heat pipe-cooled graphite-moderated micro nuclear reactor. The analysis was performed using the Monte Carlo simulation method with MCNP 6.2 software. The parameters examined included the effective neutron multiplication factor (k_{eff}), reactivity, neutron energy spectrum, fuel burn-up, neutron flux distribution, and fission power distribution. Variations in configuration were made by changing the depth of control rod insertion and the angle of rotation of the control drum, and analyzed up to five years of operating conditions. The simulation results show that increasing the depth of control rod insertion and decreasing the angle of rotation of the control drum reduces the keff and reactivity of the reactor. The control drum has a greater reactivity worth than the control rods. In addition, the control configuration has a significant effect on the uniformity of neutron flux and power distribution within the core. The neutron flux distribution becomes more uniform at a larger control drum rotation angle, while the power distribution is more homogeneous at a smaller rotation angle. The results of this study can be used as a reference in optimizing the design of a safe and efficient micro nuclear reactor control system.

***Keywords** : micro nuclear reactor, heat pipe, control rod, neutronic analysis, power distribution, MCNP.*