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Increasing cycle length and flattening power distribution in soluble boron-free small modular reactor

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Abstract

Population growth, industrial development as well as limited fossil fuel resources have motivated the study of other energies, especially nuclear energy. Small modular reactors have been introduced as an efficient energy source due to their greater safety, easy transport, electricity generation and water desalination, even in remote areas. Optimization in the nuclear fuel management to improve performance and save energy leads to cost-effective design with higher efficiency and better safety. In this research, core loading pattern optimization of system-integrated modular advanced reactor (SMART) has been considered using the new dragonfly algorithm. In addition to the selected algorithm, the efficiency of optimizing loading pattern also depends on the definition of the objective function. Two-objective functions including flattening the power distribution and maximizing the effective multiplication factor are considered. Simulations of the reactor fuel assemblies and reactor core were performed by DRAGON lattice calculation and PARCS core calculation codes, respectively. According to the final results, the cycle length and effective multiplication factor are increased for 185 days and 582 pcm, respectively. Also the fitness function is decreased from 0.905931 to 0.194527.

Keywords: optimization, dragonfly algorithm, small modular reactor, fuel management

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