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CNPGS Unit-3 Core Reloading Pattern Generation using Multi-Objective Elitist Teaching Learning Based Optimization Technique

The core reloading pattern optimization in Pressurized Water Reactors (PWRs) is a crucial task aimed at enhancing reactor performance while ensuring safety and minimizing fuel consumption. In the present study, the application of Multi-Objective Elitist Teaching-Learning-Based Optimization (MO ETLBO) technique is proposed to efficiently and effectively address the multi-objective loading pattern optimization problem for Chashma Nuclear Power Generating Station (CNPGS) unit-3. A multivariable objective function is designed to evaluate the quality of each loading pattern while maximizing critical boron concentration (CBC), minimizing power peaking factor (PPF) to optimally enhance the cycle length while ensuring adequate safety margins and design limits. It has been found that the equilibrium cycle can be further extended to 16.07 EFPDs while keeping the PPF and CBC within the design limits. To validate the effectiveness of TLBO, the optimized loading pattern of the equilibrium core is then evaluated using DONJON5 computer code for the analysis of neutronic parameters. The results determined that proposed algorithm is a promising approach for loading pattern optimization in CNPGS unit-3 offering potential improvements in reactor cycle length while ensuring safety, and overall performance.

Primary authors: ALI, Amjad (Department of Nuclear Engineering, Pakistan Institute of Engineering and Applied Sciences); Dr SHAUKAT, Nadeem (Department of Physics and Applied Mathematics (DPAM), Pakistan Institute of Engineering & Applied Sciences)

Co-author: BACHA, Meer (Department of Nuclear Engineering, Pakistan Institute of Engineering and Applied Sciences)

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