Optimal Transmission Loss Reduction and Fair Cost Allocation in Deregulated Power Systems Using Flower Pollination Optimization Algorithm

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Abstract:

The transmission system is an important part of a power system, as it transfers electrical power from generating stations to load centres that are located far away. Interconnection of different generating units through a transmission network helps in reducing the overall generation cost and also improves the reliability of the power system. In recent years, the introduction of deregulation and open access policies in the electricity sector has created a competitive environment in the power market. In such a deregulated power system, transmission loss reduction and proper cost allocation of these losses have become significant issues. The cost allocation of transmission losses is often a challenging task among electricity producers and consumers. Since both generators and loads are connected through the same transmission network, the actions of one participant may influence the power flow and losses experienced by others. In addition, the nonlinear behaviour of power flow in transmission lines makes it difficult to determine the exact responsibility of each participant for the losses. Therefore, it is essential to adopt an effective method for allocating real power losses without creating unfair conditions for market participants along with pricing mechanism. The main objective of this work is to reduce transmission losses by incorporating a Thyristor Controlled Series Capacitor (TCSC) device using the Flower Pollination Optimization Algorithm. After achieving loss reduction through optimal placement of the TCSC device, the transmission losses and pricing are allocated using the Pro-Rata loss allocation method and Power flow tracing method. In this work, the losses are distributed proportionally among the market participants as well as cost also, ensuring a fair sharing of the total generation cost between generators and loads in a deregulated power system. This work was done by testing IEEE 14 bus system using MATLAB environment.

Keywords:

Deregulation, TCSC, Pricing, Loss Allocation, Transmission system.