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Application of Swarm based Intelligent Computing Algorithms for Dynamic Evaluation of Maximum Loadability of Transmission Network

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Abstract This work proposes the application of soft computing techniques to evaluate the optimal location and control settings of Flexible AC transmission system inorder to improve the Maximum Loadability (ML) of pool, hybrid model of deregulated power system during scheduled outages like single (N-1) and double (N-2) contingencies. Particle Swarm Optimization (PSO), Hybrid Particle Swarm Optimization (HPSO) algorithms are applied for optimizing the solution. In this case study, three different FACTS devices are considered namely, series type Thyristor Controlled Series Compensator (TCSC), shunt type Static Var Compensator (SVC) and series –shunt type Unified Power Flow Controller (UPFC). To reduce the Installation cost of these devices, they are optimally located in the system based on priority indices like Contingency Severity Index (CSI) and Fast Voltage Stability Index (FVSI).This proposed approach uses Newton Raphson Power flow equations with voltage, real and VAr power, settings of FACTS devices as constraints. Hybrid structure is modeled using bilateral transactions. The problem is simulated using IEEE 57 bus systems. The ML of transmission system obtained for various numbers, settings and locations of FACTS devices are compared both numerically and graphically. It is concluded that HPSO provides better result with minimum Time of Computation (ToC) and quicker convergence.

Keywords Maximum Loadability, Contingency, FACTS devices, Priority indices, PSO, HPSO

1. Motivation

The present scenario of electrical power market is unpredictable and non-uniform growth of demand pattern. It is essential to maintain the stability of the system even during stressed condition like contingencies. Based on the contractual agreements restructured power market is classified as Pool, Bilateral contracts, hybrid model. In pool based model, only one entity will get power from the competitive power providers or generating companies (GENCOS). The power sellers will compete for injecting power in the grid. A power provider with very high bids is unable to sell his power. The buyers compete for buying power with lesser bids. If it is too very low, they are unable to get power.

Bilateral transaction is made by direct dealing between the buyers and sellers. In hybrid structure, the consumer can get the electric power either directly from the seller or from the grid.