ABSTRACT

As the world-wide consumption of electricity continually increases, more and more pressure is put on the capabilities of power generating systems to maintain their levels of power provision. The electricity utility companies operating these power systems are faced with numerous challenges with respect to ensuring reliable electricity supply at cost-effective rates. One of these challenges concerns the planned preventative maintenance of a utility's power generating units.

The generator maintenance scheduling (GMS) problem refers to the problem of finding a schedule for the planned maintenance outages of generating units in a power system (i.e. determining a list of dates corresponding to the times when every unit is to be shut down so as to undergo maintenance). This is typically a large combinatorial optimization problem, subjected to a number of power system constraints, and is usually difficult to solve.

The focus of this research was the maintenance decision problem for multi-unit systems with economic dependency. In the research, an opportunistic maintenance policy generally applicable to the economic dependency problem was proposed for developing optimal maintenance schedule. In this research, a security constrained model for preventive
generator maintenance scheduling problem. For more realistic study, system reliability indices such as power system reserve and unit forced outage rates are taken into account.

In this research, Introduces a Particle Swarm Optimization based method for solving a generation maintenance scheduling problem with many constraints. It is shown that Particle Swarm Optimization based approach is effective in obtaining feasible schedules in a reasonable time. Actual data from a practical power system was used in this research and results were compared with other methods. This research introduced a novel concept of a hybrid with Genetic Algorithms, Evolutionary Programming and Shuffled Frog Leaping Algorithm. The result suggests that hybrid model converges to better solution faster than other algorithm. It is envisaged that this hybrid approach can be easily implemented for similar optimization and scheduling problems to obtain better convergence.

This work proposes the development of different algorithms for solving the generation maintenance scheduling problem through hybrid intelligent techniques. In the solution algorithm, Hybrid Particle Swarm Optimization based Genetic Algorithm (PSO-GA), Hybrid Particle Swarm Optimization based Evolutionary Programming (PSO-EP) and Hybrid Particle Swarm Optimization based Shuffled Frog Leaping Algorithm (PSO-SFLA) methods are developed incorporating constraints on maintenance windows, the meeting of load demand together with a safety margin, the
availability of maintenance crew and general exclusion constraints. The generation maintenance scheduling problem is modelled by adopting a reliability optimality criterion, the goal of which is to level the reserve capacity.

A Thermal Power System of utility system with twelve thermal generating units in India demonstrates the effectiveness of the proposed approach. Extensive studies have also been performed on IEEE test systems of thirty two thermal generating units. The numerical results obtained from the proposed hybrid algorithms were compared with the techniques like Genetic Algorithms, Particle Swarm Optimization, Evolutionary Programming and Shuffled Frog Leaping Algorithm and other conventional methods like Dynamic Programming, Lagrangian Relaxation. These compared results reveal that the proposed hybrid algorithms are more effective in terms of maintenance cost and computation time. Conclusions are drawn with respect to the effectiveness of each variation on the hybrid algorithms. The best solutions obtained during the experiments for each test case are reported. It is found that the Hybrid Particle Swarm Optimization based Shuffled Frog Leaping Algorithm (PSO-SFLA), one among the proposed hybrid algorithm achieves very good solutions to all instances of the Generation Maintenance Scheduling problem.