Abstract

Unit commitment and generation scheduling are of utmost importance for power system planning, operation and control. Many methods have been developed for unit commitment. Prominent among them are Priority, Dynamic Programming, Lagrangian Relaxation, and the recent methods based on Expert System and Artificial Neural Networks.

Today power generation system is enriched by hydro and gas plants. Eventhough their shares are small, they are important for overall cost minimization. Hence, numerous attempts have been made to optimize hydro-thermal and thermal-gas plants. Because of ever increasing demand of electrical power and availability of large scale generating machinery, huge amount of power is being generated now in centralized thermal plants. However, these plants have created environmental problems due to inefficient burning of fuels and/or poor quality of coal. Many countries have enacted Clean Air Acts particularly applicable to generating systems. Hence, attempts are directed in the recent past towards minimization of emission level or tradeoff between cost and emission.

Modern unit commitment programs involve all types of energy sources with numerous constraints including emission level. The aim of this thesis is to use recursive technique of Dynamic Programming for unit commitment of thermal as well as mix-system subject to usual constraints along with emission constraint.

In Chapter 2, a basic formulation is developed for economic generation scheduling and a procedure is developed to form an equivalent cost function to represent a group of units, units at a plant or a system as a whole. Simple algorithms are then developed for generation scheduling for a single area as well as for interchange evaluation in multiarea system. The technique is extended to evaluate optimum generation scheduling for multifuel units.

Basic formulation is employed further in Chapter 3 for hydro-thermal, thermal-gas and also a mix-system in general. The results obtained are comparable to those of others.

Chapter 4 presents, representation of a system by an equivalent cost function which is used to develop four methods to obtain optimal combination orders of units along with their range of operation. They are-Average Full load Cost, Direct Forward Tracking Approach, Unit Ordering By AFLC & Heuristic Forward Tracking Approach and Unit Ordering by Back Tracking. Optimal ordering of units is used for a three step unit commitment methodology developed by Ayoub [69]. Optimal combination ordering of units and unit commitment is also attempted for units with multiple fuel options.

An attempt is pursued in Chapter 5 to incorporate emission constraint in generation scheduling. The problem is treated as a localized problem for a system comprising of plants with multiple units. Emission constraint is assigned to each plant and economic and environmental dispatch algorithm is developed. The aim of the dispatch algorithm is to estimate generation on economic basis subject to emission constraint. On violation of the specified level at a plant, either minimum emission dispatch is estimated or tradeoff

technique is used to satisfy emission constraint.

Based on developments reported above, Chapter 6 incorporates an attempt towards unit commitment. The methodology begins with formation of optimal combination ordering of units along with their range of operation at each plant. As per demand, units are selected from optimal combination tables and plant cost functions are formed. Using these cost functions, unit commitment schedule is obtained. The methodology is iterative to select optimum combination of units and is attempted for both thermal and mix-system. In each problem, unit commitment schedule is obtained with and without emission constraint. For emission constraint schedule, upper level of range of operation of each optimum combination ordering is corrected. That is, unit at a plant are selected on economic basis but their range of operation is decided by emission constraint. Once units are selected as per demand and constraint of emission, scheduling is then estimated with emission constraint. At the end, as per plants' units' generation, emission level is checked and if necessary, adjustment is made on units' generation at plant level so as to maintain emission level under control. Important conclusions and scope for further research have been stated in Chapter 7.