

CHAPTER 3

METHODOLOGY

3.1 Introduction

The operation of a modern power system has become very complex. It is necessary to maintain frequency and voltage within limits in addition to ensuring reliability of power supply and for maintaining the frequency and voltage within limits it is essential to match the generation of active and reactive power with the load demand. For ensuring reliability of power system it is necessary to put additional generation capacity into the system in the event of outage of generating equipment at some station. Over and above it is also necessary to ensure the cost of electric supply to the minimum. The total interconnected network is controlled by the load dispatch centre. The load dispatch centre allocates the MW generation to each grid depending upon the prevailing MW demand in that area. Each load dispatch centre controls load and frequency of its own by matching generation in various generating stations with total required MW demand plus MW losses. Therefore, the task of load control centre is to keep the exchange of power between various zones and system frequency at desired values.

3.2 Necessity of generation scheduling

In a practical power system, the power plants are not located at the same distance from the centre of loads and there fuel costs are different. Also under normal operating, the generation capacity is more than the total load demand and losses. Thus, there are many options for scheduling generation. In an interconnected power system, the objective is to find the real and reactive power scheduling of each power plant in such a way so as to minimize the operating cost. This means that the generators real and

reactive powers are allowed to vary within certain limits so as to meet a particular load demand with minimum fuel cost. This is called the “Economic Dispatch” (ED) problem.

The objective functions, also known as cost functions may present economic cost system security or other objectives. The transmission loss formula can be derived and the economic dispatch of generation based on the loss formula can also be obtained. The Loss coefficients are known as B -coefficients.

A major challenge for all power utilities is not only to satisfy the consumer demand for power, but to do so at minimal cost. Any given power system can be comprised of multiple generating stations having number of generators and the cost of operating these generators does not usually correlate proportionally with their outputs; therefore the challenge for power utilities is to try to balance the total load among generators that are running as efficiently as possible.

The ED problem assumes that the amount of power to be supplied by a given set of units is constants for a given interval of time and attempts to minimize cost of supplying this energy subject to constraints of the generating units. Therefore, it is concerned with the minimization of total cost incurred in the system and constraints over the entire dispatch period (Abido, 2001).

Therefore, the main aim in the economic load dispatch problem is to minimize the total cost of generating real power (production cost) at various stations while satisfying the loads and the losses in the transmission links.

3.3 Generator Operating Cost

The total cost of operation includes the fuel cost, cost of labour, supplies and maintenance. Generally, costs of labour, supplies and maintenance are fixed percentages of incoming fuel costs. The power output of fossil plants is increased sequentially by opening a set of valves to its steam turbine at the inlet. The throttling losses are large when a valve is just opened and small when it is fully opened. Figure 3.1 shows the simple model of a fossil plant dispatching purposes.

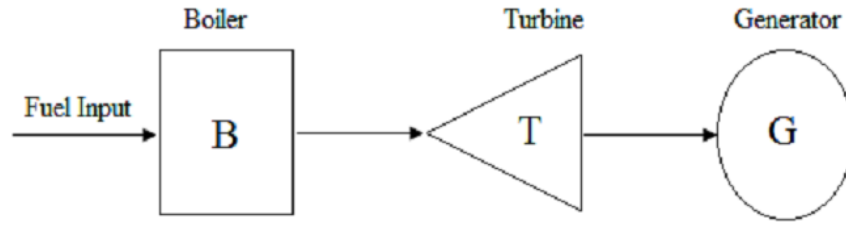


Figure 3.1: Simple Model of a Fossil Plants

Source: (Saadat, 2010)

The primary concern of ED problem is to minimize of its objective function. The objective function is formulated as below, where F is total fuel cost, N is number of generating unit and $F_i(P_{Gi})$ is operating fuel cost of generating unit i .

$$\min(F_T) = \min \sum_{i=1}^N F_i(P_{Gi}) \quad (3.1)$$

The generator cost curve is represented by quadratic functions and the total fuel cost $F_i(P_G)$ in (\$/h) can be expressed as below (Saadat, 2010):

$$F_i(P_{Gi}) = \sum_{i=1}^N a_i + b_i P_{Gi} + c_i P_{Gi}^2 \quad (3.2)$$

Where N is the number of generators; a_i , b_i , c_i are the cost coefficients of the i -th generator and P_G is the vector of real power outputs of generators.

3.4 ED with Losses Consideration

When transmission distance is very small and load density is very high, transmission losses may be neglected and the optimal dispatch of generation is achieved with all plants operating at equal incremental production cost. However, in the large interconnected network where power is transmitted over a long distances with low density areas, transmission losses are major factor and affect the optimum dispatch of generation.