Chapter 1

Introduction

The description and analysis of electric Power Systems has traditionally been given in scalar terms. Equations based on the Kirchhoff laws and inter-relationships between currents, voltages, and power are usually written and manipulated for Power Systems. However when system size exceeds a few buses, circuit data and equations become so voluminous that scalar notation is not convenient, and analysis without aid from a computer is quite tedious. It is therefore natural to turn to vector notation of voltages and currents. In this notation, the Kirchhoff laws are used for "building" the matrix elements occurring in these equations - and the term vector - matrix is used descriptively to denote the notation.

Vector - matrix notation offers a versatile notation that is amenable to digital computation and, in many ways, insensitive to system size. The latter advantage is particularly attractive since, for example, analysis of one 100 - bus system is much more difficult than the analysis of two 50 - bus systems.

Generally, there are four classical problems of

Power System analysis: Load-Flow, Shorted-circuit, Stability, and Electro-Magnetic Transient. Since the Power System Load-Flow analysis (see Chapter 2) needs a great deal of effort and computer time to find its solution, especially for very large Power Systems , large computer memories and extensive calculation time are required. Nowadays, the two major methods which require less memory and calculation time but still give accurate results are the Sparse Matrix technique and the Diakoptics or tearing method. The two methods have their own steps of calculation as follow:

1. Formulate mathematically the performance of the Power System.

2. Obtain a numerical solution.

By the Diakoptics method, the system is torn to subsystems or areas. For example, a system of 100 buses; the memory storage units required to store a 100 X 100 Bus Impedance Matrix is 10,000. If the system is torn to 5 areas of 20 buses each, the memory storage units required is only 20 X 20 X 5 which equals 2,000. The dissertation presents an application of Diakoptics to Power System Load-Flow analysis (see Chapters 4 and 5).

The advantages of Diakoptics can be summarized as shown below:

1. Reduction of the computer costs of a Load-Flow study, due to less calculation time compared to the classical method.

2. The method could be implemented in a micro-computer environment, which has less memory storage available than the mini- or main frame computer environment. For example, on an IBM-PC, it is possible run a 120-bus system Load-Flow without exchange of data to the external storage during the calculation process.

3. By the method of tearing, the multi-computer and multi-data processing is possible to apply. Each computer could work independently with its own area and pass its result to a central computer to perform functions for the whole system such as: on-line control, state estimator, economic dispatch, and so on.