# A review on load flow analysis of ring main system

Load flow analysis is an important tool used by the power engineers for planning and determining the steady-state operation of a power system. The flow of active and reactive power is known as load flow or power flow. Load flow studies help in determining the various bus voltages, phase angles, active and reactive power flows through different branches, generators, transformer settings and load under steady-state conditions [1].

The main information obtained from the load flow or power flow analysis comprises magnitudes and phase angles of load bus voltages, reactive powers and voltage phase angles at generator buses, real and reactive power flows on transmission lines together with power at the reference bus; other variables being specified [2]-[3]. The resulting equations in terms of power, known as the power flow equations become non-linear and must be solved by iterative techniques using numerical methods.

In the past three decades, the most commonly used iterative methods are Gauss-Seidel, Newton-Raphson and Fast Decoupled method [4]. Also with the growing industrial developments, the power system is becoming more complex in operation. With such huge development, any numerical mathematical method cannot converge to a correct solution. Thus power engineers have to seek more reliable methods. The problem that is faced by the power industry is to determine which method is most suitable for a power system analysis. In the analysis of Load flow, high degree accuracy and a faster solution time are the basic requirements to determine the best method to be used for a particular problem.
But accurate calculations of load flows would be impractical without the use of computer programs. The use of digital computers to calculate load flow started in the mid-1950s. There have been different methods used for load flow calculations. The development of these methods is mainly led by the basic requirement of load flow calculation such as convergence properties, computing efficiency, memory requirement, convenience and flexibility of the implementation [4]-[7]. With the accessibility of fast and large size digital computers, all kinds of power system studies, including load flow, can now be carried out appropriately and conveniently [8]. The numerical method provides an approach to find a solution with the use of a computer, therefore there is need to determine which of the numerical method is faster and more reliable in order to have the best result for load flow analysis.

The first practical automatic digital solution method appeared in the literature in 1956. The popular traditional ‘Gauss-Seidal’ iterative method which requires minimal computer storage through Y-matrix. Although the performance is satisfactory in different systems the main drawback is its converging time.

This drawback is overcome by the development of Z- matrix methods, which converge more reliably but sacrifice some of the advantages of Y-matrix iterative methods, notably storage and speed when applied to large systems. The other conventional methods like Newton-Raphson method was shown to have powerful convergence properties but was computationally uncompetitive. Major breakthrough in power- system network computation came in the mid-l960.

At present, with the increase in problem sizes, online applications, and system optimization, newer methods are emerging which are also expected to find wide applications. The brief explanation of the basic formulation of the load-flow problem is described in [2]-[4]. For review, a balanced three-phase power system along with transmission line has been considered. The universally preferred network analysis nodal admittance matrix equation is used and is as shown below

$I = Y^* E$ (1)

Where, matrix Y is square, sparse, and symmetrical (in the absence of phase shifters or mutual couplings represented by non-bilateral network branches).