SOME IMPROVEMENTS IN DISTRIBUTION SYSTEM ANALYSIS AND OPTIMIZATION

by

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CERTIFICATE

This is to certify that the thesis entitled "**SOME IMPROVEMENTS IN DISTRIBUTION SYSTEM ANALYSIS AND OPTIMZATION**" which is being submitted by Shri G. Kasi Viswanadha Raju to the Indian Institute of Technology Delhi, for the award of Doctor of Philosophy, is a bona fide research work carried out by him. He has worked under my supervision and guidance and has fulfilled the requirements for the submission of this thesis. The thesis, in my opinion, has attainted a standard required for a Ph. D degree of this institute. The results contained in this thesis have not been submitted else where in part or full for the award of any degree or diploma.

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(G. K. Viswanadha Raju)

ABSTRACT

Electric power distribution system is an important part of electric power systems. In order, to provide better services to electric consumers and to enhance the system efficiency and reliability, distribution systems have to be automated. The functions that can be automated are monitoring and control. The strength of the system operation will depend upon how, effectively and efficiently these functions are going to be implemented. For this purpose, efficient and reliable analytical and optimization tools are required. In this dissertation, an attempt has been made to develop new algorithms and models for distribution system analysis and optimization under certain and uncertain environment.

The highlights of the research work carried out in this dissertation are as follows.

A boundary value based fuzzy distribution power flow that takes into account the non-statistical uncertainties has been developed. Handling of simultaneous uncertainties in loads, load model coefficients and line parameters is considered. For this purpose, distribution power flow is modified to a form similar to Newton Raphson power flow. It does not require any inversion of Jacobian type matrix.

Augmented π-models for various types of connections of distribution transformer have been developed, which are purely based on phase variables and fit into any type of distribution power flow.

A real-time equivalent of transmission and sub-transmission system for distribution system power flow has been developed. It is based on real-time voltage and current measurements at HT bus of the distribution system.

A new Fast Decoupled Power Flow for radial distribution system has been developed. In addition, for convergence improvement and divergence control, optimal multiplier based power flow algorithms have been developed for distribution system.

A new branch wise method for weakly meshed balanced and unbalanced distribution system State Estimation has been developed.

Efficient two-stage algorithms for reconfiguration of balanced and unbalanced distribution systems have been developed to minimize real power loss of the system. The first stages of these algorithms are based on branch current and sensitivity of real power loss with branch impedance respectively. To further refine the solution obtained in first stage of the two methods, a branch exchange procedure is used in second stage for both the methods.

A simple and efficient Volt/Var control algorithm for real power loss/real power demand minimization of distribution system has been developed. It is based on sensitivity information obtained from the distribution power flow.

In order to minimize real power loss under uncertain environment, a non-linear, boundary value based reactive power/voltage control algorithm has been developed. It considers simultaneous uncertainties in load forecast, load model coefficients and line parameters.

Results for sample test systems have been obtained which validate the proposed algorithms.

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