

TRANSMISSION NETWORK EXPANSION PLANNING

by

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CERTIFICATE

This is to certify that the thesis entitled “**TRANSMISSION NETWORK EXPANSION PLANNING**” which is being submitted by Ms. Ashu Verma to the Indian Institute of Technology Delhi, for the award of Doctor of Philosophy, is a bonafide research work carried out by her. She has worked under our supervision and guidance and has fulfilled the requirements for the submission of this thesis. The thesis, in our opinion, has attained 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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ABSTRACT

Transmission network expansion planning (TNEP) is an important component of power system planning. Its task is to determine the optimal set of transmission lines to be constructed such that the cost of expansion plan is minimum and no network constraints are violated during the planning horizon. The problem is very complex due to large number of options to be analysed and the discrete nature of the optimization variables. The challenges have increased even more because of deregulated system operation. Hence, more efficient techniques are required for TNEP. Uncertainties in load specifications must also be incorporated in TNEP as the chances of their occurrence are more due to its long range nature. In this dissertation, an attempt has been made to develop new algorithms and models for TNEP in certain and uncertain environment.

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

A new simple and efficient heuristic algorithm has been developed for TNEP with and without security constraints. The presented method utilizes single/double line compensation approach for a single/double line modification simulation. The proposed approach is very efficient as it does not require refactorization of Jacobian matrix which is the most time consuming part in a power flow simulation.

A TNEP model for handling uncertainties in load forecast has been developed. Boundary DC power flow is utilized to model the non statistical uncertainties in load specifications. The TNEP is solved with two methods: 1) Basic Binary Genetic Algorithm (GA), 2) the compensation based heuristic method developed for TNEP in crisp environment has been extended to include the uncertainties in load forecast. The

proposed heuristic approach is very efficient as it does not require refactorization of Jacobian matrix.

A metaheuristic method known as bacteria foraging-differential evaluation algorithm (BF-DEA) has been presented for TNEP. Comparison of results has been made with the ones obtained with basic binary GA and particle swarm optimization (PSO).

The effectiveness of an improved harmony search (IHS) algorithm has been demonstrated for TNEP. The comparison of results has been carried out with the ones obtained with BF-DEA and basic binary GA. Also, a hybrid method having combination of heuristic method (proposed earlier) and metaheuristic method (IHS) has been proposed for TNEP.

The application of IHS for dynamic transmission network expansion planning (DTNEP) has been presented. The importance of DTNEP over static transmission network expansion planning (STNEP) has been illustrated. Also, a rolling window based approach for DTNEP has been presented.

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

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