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Congestion of transmission lines due to violation of any transfer limits not only threatens the security of power system but it also affects its economic operation. Therefore, congestion management remains the central issue to the management of power transaction in competitive environment of electricity market. However, the interaction of congestion management with energy market economics should be carefully accomplished such that market inefficiency cannot take away the benefits promised by deregulation to the society. The management of congestion in transmission lines is somewhat complex in restructured power system as compared to that in Vertically Integrated Utility. The proposed work is focused on the different techniques adopted to manage congestion efficiently in competitive electricity market such that power system economics remain intact. Three different means of managing congestion have been proposed which are by using, i) generation rescheduling ii) distributed generation and iii) FACTS devices. Also, an efficient optimization technique based on PSO has been proposed to solve the non-linear congestion management problem.

Congestion management using generation rescheduling has been done by rescheduling the real power output of generators which participated in congestion alleviation. Sensitivity of the generators to power flow on congested line has been calculated to select the generators to participate in management of congestion. Based on their generator sensitivity values, the participating generators reschedule their real power output. An effort has also been made to take the power system economics into account. To get the minimum generation rescheduling cost, the bids submitted by generators have been considered along with generators sensitivity in order to calculate the amount of real power rescheduling. The method is implemented on IEEE 14-bus system and IEEE 30-bus system. The effect of bids submitted by generators for output power rescheduling has also been analyzed which reveals that the increase of bid of a generator reduces its real power output rescheduling and accordingly, the other

generators reschedule their power output to keep the generation rescheduling cost minimum.

A zonal congestion management scheme employing distributed generation (DG) has been presented in the thesis. The identification of different congestion zones is done on the basis of LMP difference across a line connected between two buses. The buses connecting lines of high and non-uniform LMP difference across them is grouped in most sensitive congestion zone while other buses connecting a line having low and uniform LMP difference are grouped in less sensitive zones of congestion. The DG is placed in the most sensitive congestion zone. Further, to find its optimal placement in most sensitive congestion zone, LMP difference is again utilized. The DG is also placed to other potential location within the most sensitive congestion zone and in other zones which gives higher system generation cost as compared to that of previous location

A new congestion management method employing a series FACTS device has been proposed. The series FACTS device is placed optimally based on line flow sensitivity factor (LSF). The optimal placement of the FACTS device is found to achieve its minimum installation cost as well as minimum generation cost of the system. For this, a static model of TCSC is formulated and implemented in the problem. The line flow sensitivity factor with respect to control parameter of TCSC is calculated for each line based on which TCSC is optimally placed in line having most negative LSF.The proposed method has been tested on IEEE 14-bus system and has been observed that the placement of TCSC in most sensitive line determined from sensitivity analysis gives minimum installation cost of TCSC as compared to other potential locations of TCSC placement. Also the total generation cost found is less as compared to other potential locations for TCSC placement.

A reliable and efficient optimization technique to solve the non-linear congestion management problem has been implemented. PSO has been utilized in above reported work to find the amount of generation rescheduling and TCSC control parameter value. However, the selection of parameters in PSO plays an important role in its performance. Therefore, a more efficient optimization technique based on PSO is proposed to solve the congestion management problem. The new technique is termed as PSO with improved time varying acceleration coefficients (PSO-ITVAC). It is implemented in congestion management technique using generation rescheduling in order to analyze its performance and it has been observed that the problem converges to a more optimal solution with less number of iterations as compared to PSO-TVAC.