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DEREGULATED POWER SYSTEM MANAGEMENT USING FACTS DEVICES

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ABSTRACT

Power sector has seen a rapid growth day by day due to industrialization and urbanisation. In order to meet the increased energy consumption & trades due to the increase of unplanned power traffic the transmission lines are frequently operated close to or even beyond their respective thermal limits. If the power traffic is not controlled there are chances that some lines may get overloaded and this is treated as congestion. In other words, congestion occurs when the transmission network is unable to accommodate all of the desired transactions due to a violation of system operating limits. Utilizing certain physical or financial mechanism in present day competitive market each utility manages the congestion in the system using its own guidelines. Privatization and de-regulation of electrical power markets have shown a vast impact on almost every power system around the globe. As deregulation is growing rapidly in electrical power sector there is attention on open access. Open access to network provides equal opportunities to use the available transmission system to all buyers and sellers. Due to increase in electrical energy consumption and because of presence of few uncertainties in the network, the line loading of the transmission lines increases, voltage profile at buses fall resulting in losses in the system and poor power quality & system stability. Hence, there is need to manage congestion in the network to achieve improved power quality & system stability. In a vertically integrated utility market, the central agency or single utility directly controls the activities like generation, transmission and distribution. It is a fact that irrespective of relative geographical location of buyer and seller, every buyer wants to buy the power from cheapest price/generator. As a consequence of this the transmission networks evacuate the power of cheapest generators would get overloaded if the transactions are approved

INTRODUCTION

Congestion in a transmission system is due to temporary overloading of transmission elements, but when it is not addressed properly, it may lead to outages of critical transmission paths and in-turn lead to cascaded outages threatening the system security.

In a day ahead market, due consideration has to be given while executing the contracts that the approved contracts should not create any congestion even in a contingency condition. The system operator is responsible for deciding the necessary actions to ensure that no violations of the network constraints occur in a deregulated electricity market. Various works have been carried out in congestion management pertaining to deregulated power system in the last three decades. This chapter reviews the various strategies proposed in the literature for congestion management. Relieving of congestion of network is congestion management. There are two ways of congestion management: cost free method sand non cost free methods. Generally, the transmission network is limited by several limits such as stability limits, voltage limits and thermal limits with most of these limits are applicable at a given time in order to operate the electric network securely. As electric demand is increasing all over the globe, the electrical utilities forced to increase their generation in order to meet the demand. Major objective of the electrical utilities after deregulation is to operate this large electric power network securely and economically. Priority is given to the minimum price generator to meet the demand economically. As the power flow through the transmission lines which provides economical operation increases, chances of reaching the limits also increases. The system is said to be congested if such a limit is reached. Operation of power system within limits is necessary to maintain the security of the network, failing of these limits results in major blackouts and have large social and economic consequences. Therefore, controlling the transmission network for the congestion management is the most fundamental problem . In order to manage congestion, the methods adopted by system operators are generally rescheduling, load curtailment, active and reactive power support. In deregulated environment the market operator uses the available resources nearly at its rated capacity as each player wants to maximize his profit.

OBJECTIVE OF THE WORK

critical review of literature has been presented on congestion management in deregulated power system. In the review, all methods of congestion management are discussed, starting from conventional methods to most recent methods. Congestion management using Generator rescheduling and load curtailment, using Distributed Generators (DG), OPF based congestion management, using FACTS devices / Multiple FACTS devices and Optimal Sizing and Location using evolutionary algorithms has been discussed in this chapter. Following work has been carried out based on gaps identified in the literature:

- Congestion management in deregulated power system, during contingency and critical contingency condition by placement of FACTS devices.
- Technical and Economic analysis during congestion and critical contingency condition by using Multiple FACTS devices.
- Placement of Multiple FACTS for CM and their sizing considering investment cost using hybrid optimization technique.

METHODOLOGY: In unbundled electricity market managing transmission ongestion is a real challenge for independent system operator (ISO). This chapter presents placement of thyristorcontrolled series compensators (TCSC) at optimal location for maintaining voltage stability and mitigating congestion under single line contingency condition. Optimal location is found out by Line voltage stability index calculation and sensitivity index Congested lines are found out under contingency condition (single line outage). Critical contingencies are found out by finding performance index (PI). Effect of placement of TCSC under critical contingency can be observed. TCSC reduces power loss in overloaded transmission lines and has the ability to increase loadability, reduce system loss and maintains stability of power systems. Management of transmission congestion is of far reaching importance in deregulated power system. Due to congestion, power system does not remain in secured condition and leads to increase in congestion cost. Congestion problem is severe under critical contingency which leads to overloading

of transmission lines. In this chapter, performance index is used to find out severe contingency and Optimal Power Flow (OPF) is carried out with the objective of social welfare maximization. Multiple FACTS devices have been optimally placed using various methods viz. sensitivity index, Fast Voltage Stability Index (FVSI), Locational Marginal Pricing (LMP) and LMP difference method to improve technical parameters and economical facets of power system. These multiple FACTS devices have been optimally allocated to improve techno- economical parameters of congested power system under severe contingency state.

CONCLUSION

Optimal location of SVC is found out by CPF analysis and FVSI index. SVC is connected at that bus to improve voltage stability and reduce real power losses.Contingency is created and critical contingency is ranked based on performance index. Under critical contingency condition, optimal location is found by sensitivity-based approach and LVSI index-based method. TCSC is placed at optimal location andcongestion of most congested line is relieved, there is improvement in transmission efficiency and steady state stability limit. An innovative approach is used for congestion relief in deregulated power system by best allocation of multiple FACTS devices. Congestion is managed by optimal power flow (OPF) technique. Objective of social welfare maximization is achieved with the reduction in transmission congestion cost. Simulation is carried out on system which is operated in N-1 severe contingency and allocation of multiple FACTS devices for ensuring power system security. Various technical and economical parameters are considered and noticeable improvement in these parameters has been observed.

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