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Reactive Power Flow Controller

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Abstract: Wind energy's presence in the electric power system has dramatically grown over the past decade and will continue to grow worldwide as many countries have planned future developments. As wind power penetration into the grid increases, the influence of wind farms on the power system operation is becoming more and more important [1]. Wind power is gaining momentum in the world's energy balance. Several issues have to be addressed whenever power-generating devices are interfaced to the grid. Two of the main requirements are reactive power control in normal operation conditions and fault ride-through capability during fault conditions. The main purpose of normal operation requirements is to maintain the voltage between admissible limits both for security and power quality purposes. Since reactive power cannot be transmitted over long distances, it has to be provided locally. Therefore, in grid connection specifications, wind farms are generally required to contribute to reactive power control. Concerning fault condition requirements, they are aimed at avoiding as much as possible the loss of generation capacity in case of a fault in the transmission grid. Power system operators ensure the quality and reliability of supply to the customers by maintaining the load bus voltage in their permissible limits. Any changes to the system configuration or in power demands can result in higher or lower voltages in the system. This situation can be improved by reallocating reactive power generations in the system [5]. This paper presents the setting of FACTS devices like STATCOM as additional control parameters in the optimization of reactive power dispatch and studies the impact on system loss minimization. This proposed work is carried out in offline full-scale simulations in PSCAD simulation software. This paper concludes that STATCOM at the grid connection point can mitigate reactive power, improve voltage profile.

Keywords: STATCOM, Reactive Power Dispatch, PSCAD.

I. INTRODUCTION

The optimal power flow problem is to minimize the fuel cost, system losses or some other appropriate objective function while maintaining an acceptable system performance in terms of limits on generator real and reactive power output, output in compensating devices, transformer tap settings or bus voltage levels etc. When only total fuel cost is minimized the optimal power flow problem corresponds to an Economic Load Dispatch (ELD) sub problem. As the system transmission loss depends on reactive power injection, the minimization of loss problem corresponds to the Optimal Reactive Power Dispatch (ORPD) sub problem condenser. To solve this complex problem several methods based on sensitivity relationship are reported in published research literature.Optimal Reactive Power Dispatch is one of the application functions of modern Energy Management System, used to minimize total system real power loss and improve voltage profile. Optimal Reactive Power Dispatch computes optimal settings of reactive power output or terminal voltage of generating plant, transformer tap settings and output of other compensating devices such as capacitor banks and synchronous condenser. To solve this complex problem several methods based on sensitivity relationship are used [6]. The concept of using solid state, power electronic converters for power flow control at the transmission level have been known as FACTS. The idea has had some success in certain areas such as VAr dispatch and control. However, the full use of FACTS for power flow control has had limited application in part due to reliability concerns, and in part due to availability of components. The potentional improvement of the transient response of a system with FACTS devices is a very important consideration in many applications.
This paper has presented the setting of STATCOM for optimization of reactive power dispatch and studies the impact on system loss minimization. This proposed work is carried out in offline full-scale simulations in PSCAD simulation software.

II. OPTIMAL REACTIVE POWER DISPATCH

The main task before utility is to meet the load demand of system most economically while ensuring desired quality of supply to consumers. The quality of supply is judged in terms of constant voltage. Extra reactive power demand from load increases magnitude of current in the system due to which real power loss is increased. Thus voltage drop in the system is increased, which reduces terminal voltage. Reactive power developed in transmission line is proportional to voltage drop in the system. If the extra reactive power demand of load is supplied separately instead of providing it from generator keeps current magnitude constant in the system. Thus maximum real power can be