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Improvement of Voltage Stability in EHV AC Transmission Line

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Abstract: *The fundamental principle of a STATCOM installed in a power system is the generation ac voltage source by a voltage source inverter (VSI) connected to a dc capacitor. The active and reactive power transfer between the power system and the STATCOM is caused by the voltage difference across the reactance. The STATCOM can also increase transmission capacity, damping low frequency oscillation, and improving transient stability. The STATCOM is represented by a voltage source, which is connected to the system through a coupling transformer. The voltage of the source is in phase with the ac system voltage at the point of connection, and the magnitude of the voltage is controllable. The current from the source is limited to a maximum value by adjusting the voltage. Mathematical modeling and analysis of static compensator (STATCOM) is presented in it. It explains the use of STATCOM for improvement of transient stability and power transfer*

Keywords: STATCOM, VSI, FACTS, BESS, TCSC

I. INTRODUCTION

The power systems today are complicated networks with hundreds of generating stations and load centers being interconnected through power transmission lines. An electric power system can be subdivided into four stages: i) Generation, ii) Transmission iii) Distribution and The power system is a highly nonlinear system that operates in a constantly hanging environment; loads, generator outputs, topology, and key operating parameters change continually. When subjected to a transient disturbance, the stability of the system depends on the nature of the disturbance as well as the initial operating condition. The disturbance may be small or large. Small disturbances in the form of load changes occur continually, and the system adjusts to the changing conditions. The system must be able to operate satisfactorily under these conditions and successfully meet the load demand. It must also be able to survive numerous disturbances of a severe nature, such as a short circuit on a transmission line or loss of a large generator. Now-a-days it is becoming very difficult to fully utilize the existing transmission system assets due to various reasons, such as environmental legislation, capital investment, rights of ways issues, construction cost of new lines, deregulation policies, etc. Electric utilities are now forced to operate their system in such a way that makes better utilization of existing transmission facilities. Flexible AC Transmission System (FACTS) controllers, based on the rapid development of power electronics technology, have been proposed in recent years for better utilization of existing transmission facilities. With the development of FACTS technique, it becomes possible to increase the power flow controllability and enhance power systems stability. Recently, Flexible Alternative Current Transmission System (FACTS) controllers have been proposed to enhance the transient or dynamic stability. During the last decade, a number of control devices under the term FACTS technology have been proposed and implemented. Application of FACTS devices in power systems, leads to better performance of system in many aspects. Voltage stability, voltage regulation and power system stability, damping can be improved by using these devices and their proper control There are various forms of FACTS devices, some of which are connected in series with a line and the others are connected in shunt or a combination of series and shunt. The FACTS technology is not a single high power controller but rather a collection of controllers which can be applied individually or in coordination with other to control one or more of the inter related system parameters like voltage, current, impedance, phase angle and damping of oscillations at various frequencies below the rated frequency. Among all FACTS devices, static synchronous compensators (STATCOM) plays much more important role in reactive

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power compensation and voltage support because of its attractive steady state performance and operating characteristics.

II. Transmission Transfer Capability Concepts

The key basic concepts of transmission transfer capability are described below. Numerous other terms related to transfer capability are explored in detail in NERC‟s May 1995 Transmission Transfer Capability reference document. The concepts and terms in that document are still applicable in an open transmission environment. 2.1 Transfer capability Transfer capability is the measure of the ability of interconnected electric systems to reliably move or transfer power from one area to another over all transmission lines (or paths) between those areas under Stability of power system-specified system conditions. The units of transfer capability are in terms of electric power, generally expressed in megawatts (MW). In this context, “area” may be an individual electric system, power pool, control area, sub-region, or NERC Region, or a portion of any of these. Transfer capability is also directional in nature. That is, the transfer capability from Area A to Area B is not generally equal to the transfer capability from Area B to Area A.

III. Literature Review

1..J.P. Aditya, A. Nikhil, B.H. Chowdhury, “Application of STATCOM for improved reliability of power gridcontaining a wind turbine,” 2008 IEEE Power Engineering Society General Meeting, July 2008 this paper gives Integration of STATCOM with vitality stockpiling gadgets assumes a basic part in enhancing the power framework operation and control. Noteworthy research has been done around there for down to earth acknowledgment of advantages of the reconciliation

2. B. Ted, “A novel control scheme for a Doubly-fed induction wind generator under unbalanced grid voltage conditions,” CEME Tele seminar, April 2007,This paper obviously demonstrates the presence of force quality issue because of establishment of twist turbines with the network. in this proposed plot a FACTS gadget {STATIC COMPENSATOR (STATCOM)} is associated at a state of basic coupling with a battery vitality stockpiling framework (BESS) to diminish the power quality issues.

3.M.S. ElMoursi, A.M. Sharaf, “Novel STATCOM Controllers for VoltageStabilization of Stand Alone Hybrid (Wind/Small Hydro) Schemes,” International Journal of Emerging Electric Power Systems, Vol. 7, Issue 3, Article 5, 2006, This paper obviously demonstrates the presence of force quality issue because of establishment of twist turbines with the network. in this proposed plot a FACTS gadget {STATIC COMPENSATOR (STATCOM)} is associated at a state of basic coupling with a battery vitality stockpiling framework (BESS) to diminish the power quality issues. The battery vitality stockpiling framework is coordinated to bolster the genuine power source under accentuating wind control. The FACTS Device (STATCOM) control plot for the framework associated wind vitality

4. Li Chun, Jiang Qirong, XuJianxin, “Investigation of voltage regulation stability of static synchronous compensator in power system,” 2000. IEEE Power Engineering Society Winter Meeting, vol. 4, pp. 2642-47, 23-27 Jan. 2000 This paper is to meet the strict criteria of matrix codes for the incorporated twist cultivate with the framework has turned into a noteworthy purpose of sympathy toward architects and analysts today. More overvoltage solidness is a key component for the steady operation of matrix associated twist cultivate amid blame ride through and framework unsettling influences. This paper explores the execution and examination of FACTS gadgets like STATCOM and SVC for the voltage steadiness issue for DFIG-based wind cultivate associated with a lattice and load. The study incorporates the usage of FACTS gadgets as a dynamic voltage restorer at the purpose of basic coupling to keep up stable voltage and along these lines securing DFIG-based wind cultivate interconnected forces framework from detaching amid and after the aggravations. The power framework model is mimicked in MATLAB/SIMULINK and the outcomes demonstrate that the STATCOM is superior to SVC for the steady operation of wind turbine generator framework to stay in administration amid lattice blame.

5. V. Salehi, S. Afsharnia, S. Kahrobaee, “Improvement of voltage stability in wind farm connection to distribution network using FACTS devices,” 32nd Annual Conference on IEEE Industrial Electronics, pp. 4242-7, Nov. 2006 This paper displays an organized voltage control plot for enhancing the system voltage profile and for minimizing the relentless state stacking of the STATCOM to successfully bolster the frame work amid possibilities. The paper addresses usage issues connected with essential voltage control and ideal following auxiliary voltage control for wind

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parks in view of self-energized acceptance generators which include STATCOM and under-load tap changer (ULTC) substation transformers. The voltage controllers for the STATCOM and ULTC transformer are composed and guarantee the voltage bolster. In unfaltering state operation, the voltage is controlled by just venturing the tap changer when the voltage is outside the dead band area of the ULTC to minimize the quantity of taps changes. Consequently, the STATCOM will be emptied and prepared to respond with higher receptive power edge amid possibilities. In the paper, the impacts of the short out proportion of the interconnection and the inalienable correspondence delay between the wind stop and the remote transport on the execution of the controllers and the greatest basic clearing time of blame are considered. Reenactment results are exhibited to show the execution of the controllers in relentless state and in light of framework possibility circumstances.

6. K. Johnsen, B. Eliasson, "SIMULINK Implementation of Wind Farm Model for use in Power System Studies," Nordic Wind Power Conference, ChalmersUniversity of Technology, March 2004 This paper exhibits a presentation and utilization of certainties controller in wind control station for enhance voltage profile. damping motions, stack capacity, lessen dynamic and receptive power misfortunes, sub-best in class on improvement of various execution parameters of influence frameworks, for example, voltage profile, sub-synchronous reverberation (SSR) issues, transient security, and element execution, by ideally set of FACTS controllers, for example, TCSC, SVC, STATCOM,SSSC, UPFC, IPFC, HPFC in wind control Systems. Additionally this paper introduces the present status on improvement of various execution parameters of force frameworks by ideally put of FACTS controllers in wind control Systems.

7. C. Schauder, H. Mehta, Vector analysis and control of advanced static VAr compensators IEE Proceedings Generation, Transmission and Distribution, vol. 140, pp. 229-306, July 1993.A shunt associated voltage source inverter (VSI) with a capacitor in the DC side working as a Static Compensator (STATCOM) and a shunt capacitor are utilized for directing the generator terminal voltage and breaking point the responsive power request from the lattice..Shut frame relentless state qualities conditions for the framework are utilized to decide key factors and to exhibit how. the operation of the framework relies on upon different parameters. These qualities bend which contains the majority of the conditions of the framework gives the all in one quick view to the inborn attributes of the framework and the impact of the parameter minor departure from the terminal voltage.

IV. Modelling Of Power System

In this paper, power systems components, models which are required for stability analysis and power transfer capability will be used. These components include: synchronous machines and their controllers, such as excitation systems and governors, transmission system, static and dynamic load demands, and systems control devices such as Flexible Alternative Current Transmission System (FACTS) devices. Mathematical models of these components coupled via the network leads to a set of DAE to represent the power system as a whole. The models are those in the positive phase sequence which is intended for system studies in balanced operating conditions. However, if required, the positive phase sequence models can be augmented with the negative and/or zero phase sequence models for studies in unbalanced operating conditions. The conditions on the interconnected network continuously vary in real time. Therefore, the transfer capability of the network will also vary from one instant to the next. For this reason, transfer capability calculations may need to be updated periodically for application in the operation of the network. In addition, depending on actual network conditions, transfer capabilities can often be higher or lower than those determined in the off-line studies. The farther into the future those simulations are projected, the greater is the uncertainty in assumed conditions. However, transfer capabilities determined from simulation studies are generally viewed as reasonable indicators of actual network capability [13].

V. Result

Sim Power Systems and different results of the Physical Modelling item family cooperate with Simulink to show electrical, mechanical, and control frameworks Sim Power Systems works in the Simulink environment. Control frameworks are blends of electrical circuits and electromechanical gadgets like engines and generators. Engineers working in this teach are always enhancing the execution of the frameworks. Prerequisites for radically expanded effectiveness have constrained power framework planners to utilize control electronic gadgets and modern control framework ideas that duty conventional investigation instruments and methods.

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A typical quality of these frameworks is their utilization of force gadgets and control frameworks to accomplish their execution goals Sim Power Systems is a present day outline device that permits researchers and designers to quickly and effectively assemble models that re-enact control frameworks. Sim Power Systems utilizes the Simulink environment, permitting you to construct a model utilizing basic snap and drag methodology. Not just would you be able to draw the circuit topology quickly, yet your investigation of the cooperation with mechanical, warm, control, and different orders. This is conceivable in light of the fact that all the electrical parts of the recreation associate with the broad Simulink displaying library. Sim Power Systems and Sim Mechanics share an extraordinary Physical Modelling piece and association line interface.

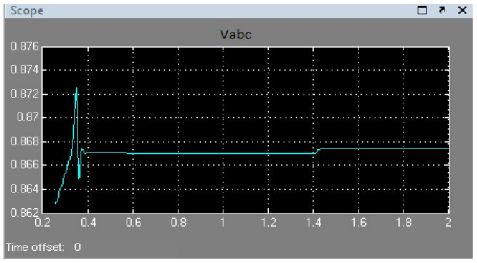

Fig.1 Output power without STATCOM in wind system

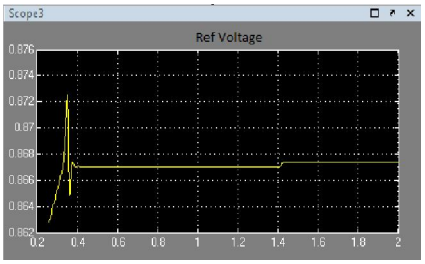

Fig.2 Output voltage of bus bar without STATCOM in wind system

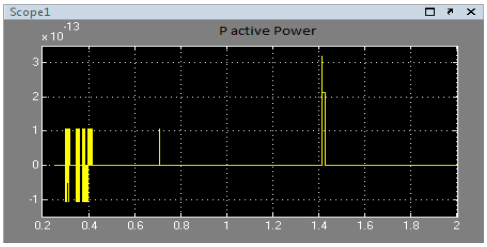

Fig. 3 Output power with STATCOM in wind system (active power)

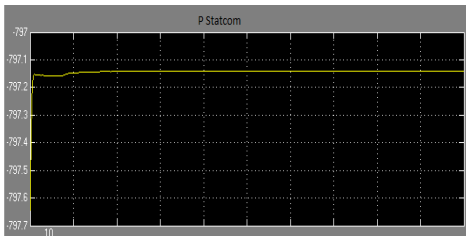

Fig.4 Output power with P STATCOM in wind system

VI. CONCLUSION

In the past segment, we have demonstrated results for various conditions in first condition we have indicated figure which are the uncompensated yield comes about here the low power and high responsive power. These are uncompensated yields (with out utilize STATCOM) by examination of plainly control calculate enhance and receptive power repaid and wind framework execution change utilize STATCOM (utilizing STATCOM) A squeezing interest for more electric power combined with the draining regular assets have prompted to an expanded requirement for vitality creation from renewable sources, for example, wind and sun powered vitality. The electrical yield control produced from these wellsprings of vitality is variable in nature and henceforth, effective power control is required for these vitality sources. Wind control has seen expanded entrance in the later past and certain stringent matrix interconnection necessities have been produced. Wind turbines must have the capacity to ride through a blame without separating from the matrix. At the point when a wind ranch is associated with a feeble power lattice, it is important to give productive power control amid typical working conditions and upgraded bolster amid and after deficiencies. Voltage precariousness issues happen in a power framework that is not ready to take care of the responsive power demand amid shortcomings and substantial stacking conditions. Dynamic pay of receptive. power is a compelling measure of protecting force quality and voltage steadiness.

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