International Organization of Research & Development (IORD)
ISSN: 2348-0831
Vol 10 Issue 01 | 2022

Improvement of Power Quality of Wind Power Using FACTS Devices

Mr. Manoj R. Wankhade[1]
[1] *Lecturer, Electrical Department, Padm. Dr. V. B. Kolte College of Engineering, Malkapur, Maharashtra, India*

DOI: 10.5281/zenodo.7162267

ABSTRACT

In recent years, wind power is highly developed inmany countries. Because due to the limitation of fossil fuels and environmental issues. But the main issue in wind power is stability. This is not stable because the wind is not constant at all time. Due to this, the stability problems accurse and quality of power is also reduced. But now days, many types of facts devices are used for power quality improvement. The STATCOM, SVC and fuzzy logic controller are the first generation facts devices which are used for power quality improvement. But second generation facts devices UPFC and IPFC is also used for power quality improvement. The fluctuation which is generated by the wind turbine is compensated by the battery energy storage system (BESS). In this review paper, various types of power quality issues and facts devices are described, which affect the power factor of transmission line. By using Facts device we improve the quality of connected device there are many instruments or equipment based on FACTS device controller.

Keyword: ***- Power quality, harmonics, UPFC, IPFC andSTATCOM.***

1. INTRODUCTION

In recent years, the wind power is most important and promising source of renewable energy. The wind energy conversion system are the fastest growing renewable energy source because due to the social, environment and economic benefits. The power quality is a problem which enables the equipment to work properly. Good power quality improves thesystem performance and improves the stability of system. Butpoor power quality produces the losses in system. The factor which is considered in the power quality is active power, reactive power, voltage variation and harmonics. But by usingthe STATCOM, we can mitigate the power quality issues. TheSTATCOM is connected to point of common coupling with abattery energy storage system (BESS). In this review paper weanalysis the factor which are analysis the power quality problems in the wind energy conversion system and by using the facts devices we can improve the power quality of wind energy conversion system.

2. LITTERATURE SURVEY

For voltage stability, the second generation fact device are used which compensates and balance the power flow in multiline. The interline power flow controller (IPFC) is also used for controlling the active and reactive power in lines. The interline power flow controller consist a voltage source converter based two facts controller for series compensation. The reactive voltage injected by individual voltage source converter can be controlled to regulate the active power flow in the lines. In this system 4-Bus system is present. The open and closed loop model is also developed and used for simulation. The IPFC is connected through the series coupling transformer and comparison of active and reactive power of transmission line with and without IPFC is presented using the proposed circuit model. In this model SSSC is used one on each line of two lines. MATLAB with Simulink and SIM POWER SYSTEM tools are used for simulation of transmission line and results are compared. The IPFC is open loop and closed loop configuration is also described. The interline power flow controller is basically a voltage source converter based flexible ac transmission system controller for series compensation with unique capability of power flow management among the multiline transmission system of a substation. In this system, for voltage stability, the second generation fact device are used which compensates and balance the power flow in multiline. The interline power flow controller (IPFC) is used for controlling the power flow in lines. The interline power flow controller consist a voltage source converter based facts controller for series compensation. The reactive voltage injected by individual voltage source converter can be controlled to regulate the active power flow in the line. In this system 4-Bus system is present. The open and closed loop model is developed and used for simulation of system.

3. POWER QUALITY ISSUES

The power quality of system is effected due to the harmonic generation, voltage sag, voltage swell, and Overcurrent and flickering. To improve the power quality of system, firstly reduce these parameters.

The main factor which affects the power quality is given below.

1. Voltage sags
2. Voltage swells
3. Inrush
4. Transient
5. Overcurrent
6. Flickering

This is very difficult to identify the whether the cause of power quality is consumers side or suppliers side. The power quality is common problem for suppliers and user's system. The power disturbance can be classified into the following categories.

A. POWER OUTAGE

The total interruption of supply is called a power outage. The power outage is an accrue problem is due to the ice storms: lightning: wind: utility equipment failure. The effect is complete interruption in the supply system.

B. VOLTAGE FLUCTUATION

Every piece of equipment is particular range of input voltage. When the voltage is above or lowers than this voltage. Then this is called a voltage fluctuation. The voltage fluctuation is accruing due to the sudden changes in the load and when the large equipment is on and off. The effects of voltage fluctuation is light is flicker and equipment is shut down. The motor will also stopping.

C. TRANSIENTS

The transients are also called surges. This type of disturbance is accruing for very short time. The equipment down the line because when transients accrue many voltages can be generated into the electrical system. The main causes of transients are suddenly starting or shut down the equipment. Example is welding equipment. The main effect of transients is burned circuit boards and the equipment is damage.

D. HARMONICS

Harmonics are the distortion of the sine wave. The harmonics are accruing due to the nonlinear loads. The effects of harmonic is overheating of equipment and neutral is also hot.

4. FACTS DEVICES FOR WIND POWER QUALITY IMPROVEMENT

Now days, many types of facts device are used for controlling the active and reactive power of system. For wind power controllers are STTCOM, unified power flow controller and interline power flow controller are widely used.

a. STATCOM (STATIC SYNCHRONOUS SERIES COMPENSATOR)

The STATCOM is a shunt connected device which compensates the reactive power. The STATCOM is capable of generating or absorbing the reactive power. The output of this controller is capable of controlling the specific parameter of electrical power system. Basically the static synchronous series compensator is improve the following such areas.

- Control of voltage flickering.
- Transient stability
- Improve the damping of power transmission system
- The dynamic voltage controlling in the distribution system.

In the STATCOM consist of a two voltage source converters and coupling a shunt connected transformer. The configuration of STATCOM is shown in fig. no.1.

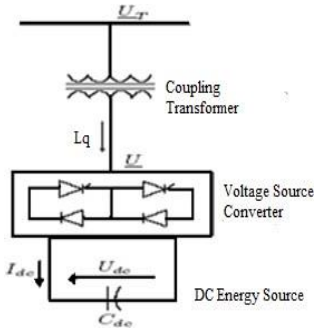


Fig 1: Static Synchronous Compensator (STATCOM)

b. UNIFIED POWER FLOW CONTROLLER (UPFC)

The unified power flow controller is a second generation facts device. This is normally used for power quality improvement of wind power. In the unified power flow controller consist of a two voltage source converters, one acts as a shunt connected device and another act as a series connected device. One act as STATCOM and another act as a static synchronous series compensator (SSSC). The DC link is provided by a storage capacitor. The configuration of unified power flow controller is shown in fig.2. The converter1 of unified power controller is operating in unity power factor.

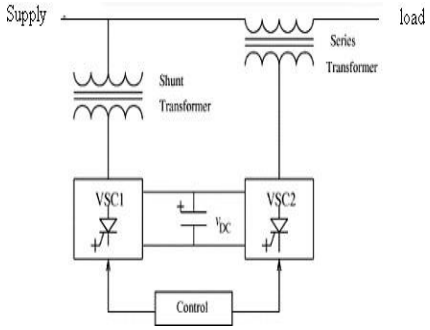


Fig 2: Unified Power Flow Controller

c. INTERLINE POWER FLOW CONTROLLER (IPFC)

The interline power flow controller is a second generation facts device. This is mostly used for power quality improvement of wind power system.

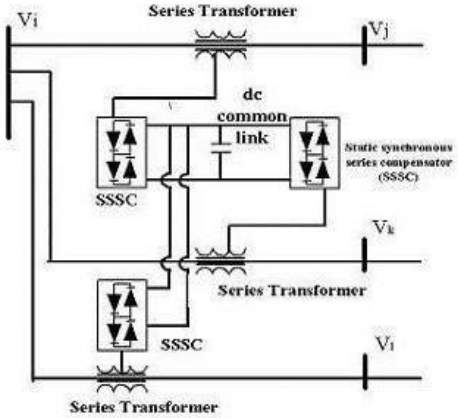


Fig 3: Configuration Of Interline Power Flow Controller

The main advantages of interline power flow controller is control the power in multiline as compare to devices STATCOM, fuzzy logic and svc control the power in only single line. The advantage is interline power flow controller is series connected device. The static synchronous series converter and interline power flow controller are the two converter in facts library which is series connected devices. The configuration of interline power flow controller is shown in fig.3.

In the IPFC controller consist of a two voltage source converter, both acts as a static synchronous series converter. The DC link between the both converters is provided by the storage capacitor.

d. Statics Synchronous Series Compensator (SSSC)

The static synchronous series compensator is also second generation facts device which control the active and reactive power of system. The static synchronous series compensator injects the voltage with variable magnitude and phase angle. The configuring of SSSC is shown in fig.4. It consists of two voltage source converter which controls the power in system. The main characteristics of SSSC are control the power in both heavy and light loads. The primary function of SSSC is control the power in transmission line. The static synchronous series compensator is also series connected device. But other controllers are shunt connected devices.

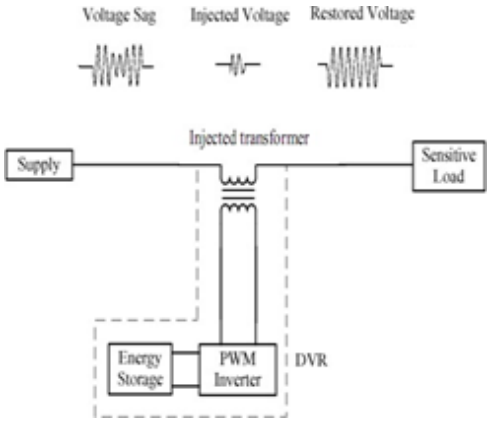


Fig 4: Configuration of Static Synchronous Series Compensator

e. STATIC VAR COMPENSATOR (SVC)

The static VAR compensator is also used for power quality improvement of wind power system because it can control the active and reactive power of system. The primary function of static var compensator is to control the voltage at week point of system.

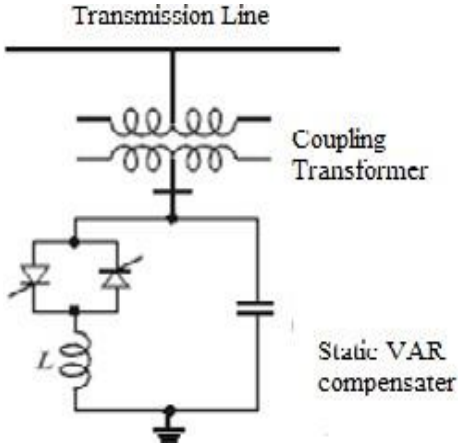
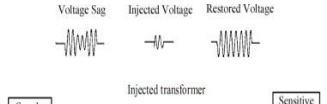


Fig 5: Configuration of SVC

5. CONCLUSION

In this paper analysis the factor which are responsible for power quality problem. For improvement in power quality of wind power, there are many controllers are used. These controllers are static VAR compensator, fuzzy logic, static synchronous compensator, static synchronous series compensator, UPFC and IPFC. These controllers eliminate the harmonic and improve the stability of system. These controllers control the reactive and active power of system and increase the transfer capability of line because in the wind power, the output of wind power is depend upon the wind which is not constant at all time. Due to this first and second generation facts devices, we can stable the wind power output.



6. REFERENCES

[1] S. Piyush, Md. Nagib, S. Subarna (2013) "Voltage stability improvement using fuzzy logic control system" International Journal of Scientific and Engineering Research, Volume 4, Issue 10.

[2] M. Indra, K. Sanjiv (2012) "Control of active and reactive power in multiline throw IPFC", International journal of emerging technology emerging technology and advanced engineering, Volume 2, Issue 11.

[3] Roopesh Kumar, Ashish Chubby (2014) "voltage stability improvement using svc and fuzzy logic controller in multimachine" international journal of electrical and electronics research. Vol. 2, Issue 2, pp: (61-66)

[4] Avinash Singh, Balwinder Singh Surjan (December 2013), "power quality improvement using fact devices", International journal of engineering and advanced technology, Volume-3, Issue-2.

[5] Sayed-mahdi Moghadasi (APRIL 2008), Ahad kazemi. "Composite system reliability assessment Incorporating an interline power floe controller", IEEE Transactions on Power Delivery, vol. 23, no. 2.

[6] P.Loganthurai, G Mani kandan (March 2014), "Modeling of grid connected hybrid system with fuzzy logic controller for voltage regulation", International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 3.

[7] Eftichios koutroulis, Kostas kalaitzakis (April 2006), "Design of a maximum power tracking system for wind energy conversion applications, IEEE transactions on industrial electronics, vol.53, no.2.

[8] Amir Khayaei (7 June 2011) "Analysis of interline power flow controller (IPFC) location in power transmission system". Research Journal of Applied Sciences, Engineering and Technology 3(7): 633- 639.

[9] A. P.Usha Rani, B. S.Rama Reddy (3 June 2007) "Modeling and digital simulation of interline power flow controller system". International Journal of Computer and Electrical Engineering, Vol. No.2.

[10] D.Lakshman Kumar, K.Ram Charan (August 2012) "Master slave control of interline power flow controller using PSO technique". International Journal of Engineering Research and Applications (IJERA), vol.no.2.

[11] Yaosuo Xue, Chenxi Lin, Maria Tamayo (2011) "Voltage stability and sensitivity analysis of grid-connected photovoltaic system", 978-1- 4577-1002-5/11/$26.00 ©2011 IEEE.

[12] J.Muruganandham, transmission systems (2012) "performance analysis of interline power flow controller for practical power system". 2012 IEEE Students' Conference on Electrical, Electronics and Computer Science.

[13] Prity bisen, Amit shrivastava (2013) "comparison between svc and statcom facts devices for power system stability enhancement", International Journal on Emerging Technologies 4(2): 101-109(2013)