# Simulation Analysis of Stability Problem in Wind Generator by using STATCOM

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***Abstract*- This paper presents a method to enhance the stability of a grid-connected wind generator composed of a fixed-speed wind turbine generator system (WTGS) using a FACTS devices of static synchronous compensator (STATCOM). Fault create at t=1.0sec to 1.02 sec and observe simulation waveform. Finally observe Simulation base comparison of system without STATCOM and system with STATCOM and Analyses transient voltage stability of wind generator.**

**This paper research work in Simulation base Analysis of transient voltage Stability of grid connected generator using STATCOM.**

***Index Terms*- Stability, grid, Induction generator, STATCOM**

## INTRODUCTION

Now a day, the renewable energy sources like as wind and solar considered as best alternative energy sources. The output electrical power from wind generator varies due to the different environmental situation like that air velocity conditions. The generated electrical power from wind generator is always fluctuating due to environmental conditions. Because of the asynchronous operation nature, system instability of wind farms based on FSIG (Fixed speed Induction Generator) is largely caused by the reactive power absorption by wind generator Due to the large rotor slip during fault.

Turbine o/p power

$$A = \pi r^2 \quad (1.1)$$

$$Where\ r\ is\ bled\ radius$$

$$= \pi\ (28)^2$$

$$=\ 2463\ sqare\ meter$$

$$P_t = \frac{1}{2}\rho \times A \times V^3\ cp \quad (1.2)$$

$$P_t = \frac{1}{2}1.23 \times 2463\ \times 12^3\ \times 0.59$$

$$Where\ 0.59\ bet's\ Constant$$

$$= 1544\ kw\ \cong\ 1.5mw$$

rpm Calulation

$$rpm = \frac{Hz \times v \times TSR}{\pi D} \quad (1.3)$$

$$Where\ v = Velocity\ of\ air\ 12m/sec.$$

$$= \frac{50 \times 12 \times 6}{\pi 56} = 27.28\ rpm$$

System diagram

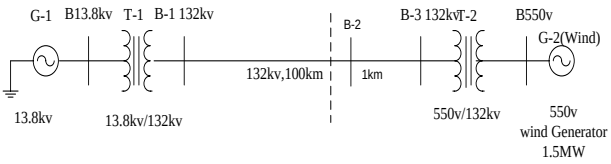


Fig. 1 Single line diagram of system

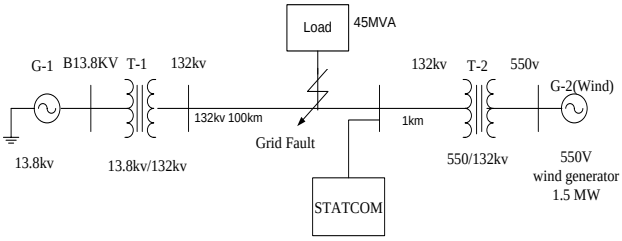


Fig. 2 Single line diagram with grid fault in system

In system fault create line to ground fault and analyze MATLAB simulink result. Fault at time t=1.0sec to 1.02sec. fault is one type of disturbance and system stability problem create so using FACTS device STATCOM to improve stability of system and compare the without STATCOM.

Per unit system and calculation.

Following basic equation of per unit value

$$Per\ unit\ valu = \frac{acual\ value\ in\ any\ unit}{base\ or\ reference\ value\ in\ the\ same\ unit} \quad (1.4)$$

*Actual kv = 132*

$$kv_{base} = \frac{132 \times 10^3}{\sqrt{3}} = 76210.2355$$

$$= 76.210$$

$$\boldsymbol{I_{base}} = \frac{209.95}{\sqrt{3}}$$

$$= 121.21 \quad (1.5)$$

$$V_{abc}\ in\ p.u. = \frac{KV_{actual}}{KV_{base}}$$

$$V_{abc}\ in\ p.u. = \frac{132000}{76210} = 1.72 p.u.$$

$$I_{abc}\ in\ p.u. = \frac{I_{actual}}{I_{base}}$$

$$I_{abc}\ in\ p.u. = \frac{209.95}{121.21} = 1.732 p.u. \qquad (1.6)$$

Active Power or Real Power = 41726.8kW ≅ 41MW

Reactive power = 11000kVAr ≅ 11 MVAr

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$$Power\ KVA = \sqrt{kW^2 + kVAr^2} \qquad (1.7)$$

$$Power\ KVA = \sqrt{41726.8^2 + 11000^2}$$

$$= 43152.35 \cong 43\ MVA$$

Transmission line current calculation

$$I_{line} = \frac{48000 \times 1000}{132 \times \sqrt{3}} = 209.95\ A \qquad (1.8)$$

Simulation and result:

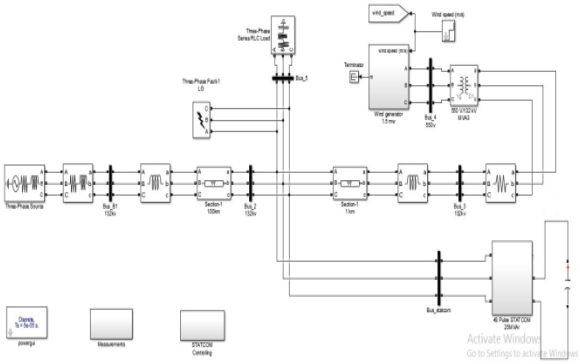

Fig. 3 Simulation of grid connected wind generator with STATCOM

Simulation model Powergui Descret mode run for t=2sec.132kv transmission by three phase voltage source. 132kv transmission line in two section respect to 100km Nominal pi model of transmission line and 1km Nominal pi model of transmission line.

Simulation in used Squirrel case induction generator rating 550v 1.5MW. 550v step to 132kv by transformer and then fed in 132kv grid.

Wind speed initially 5m/s and then increase to 9 m/s. and final value is maximum wind speed consider 12m/c

At t=1.0sec to 1.02 sec create a LG fault between one phase-A and ground. At a fault time system behave a unstable.

STATCOM controlling block diagram

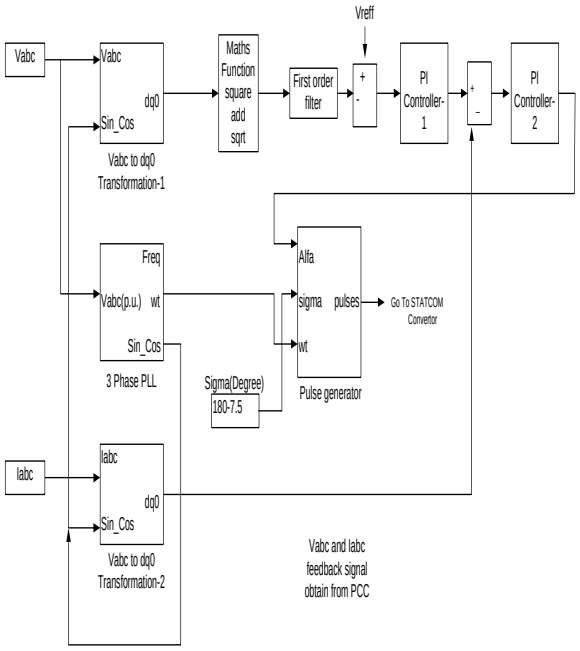


Fig. 4 Controlling of STATCOM

Controlling Signal Generating by control system STATCOM. Controlling is nothing but one type of feed back system. $V_{abc}$ , $I_{abc}$ Feedback signal for controlling.

Controlling Vabc to dqo transformation theory used . Vabc to dqo_1 and vabc to dq0_2 block is phase loop locked by 3 phase PLL block. first order filter is basically low pass filter.

In controlling system 2 PI controller used.both PI Controller kp and ki gain is different-different.

[A] Simulation run without STATCOM

Wind generator Waveform without STATCOM.

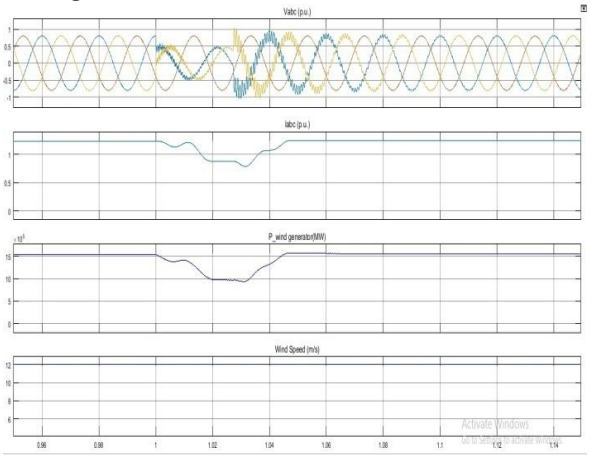


Fig. 5 Waveform of wind generator without STATCOM

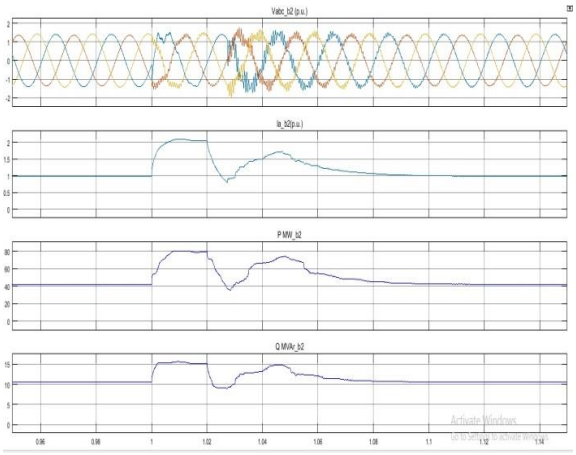

Fig. 6 Without STATCOM bus 2 measurements

[B] Simulation run With STATCOM

Wind generator bus waveform with 25MVAr STATCOM Connected

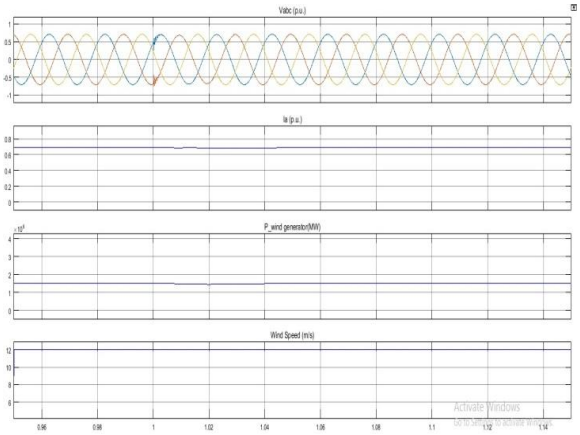

Fig. 7 wind generator bus waveform with 25MVAr STATCOM Connected

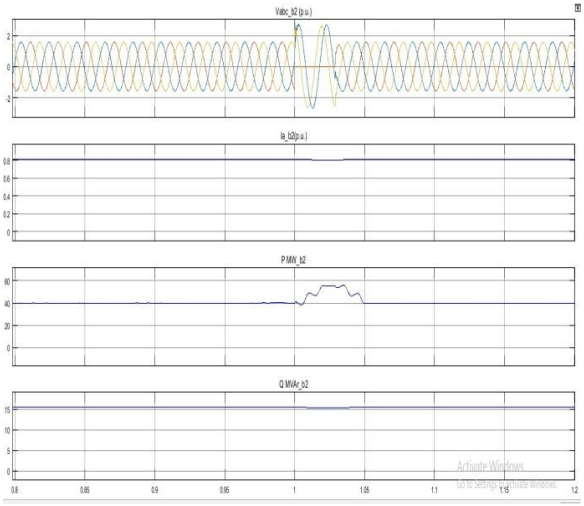

Fig. 8 Bus 2 measurement with 25MVAr STATCOM Connect

## CONCLUSION

The detailed results of fault(**LG**) without STATCOM and Fault with STATCOM has been noted and analyzed in Simulation with proper justification.

In view of that, From Fig. 5 wind generator bus measurement without STATCOM Waveform of fault during 1.0sec to 1.02 sec during observes waveform. When after the fault clearing then about voltage unstable during 1.1 sec then voltage is stable

When the STATCOM connect with grid and obtain measurement of wind generator fig. 7 Then System voltage unstable about 1.028sec then system voltage is stable.

So justify when system including with STATCOM then Transient voltage stability is improve.

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