ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

POWER QUALITY IMPROVEMENT AND INTERFACING OF WIND ENERGY SOURCE

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ABSTRACT
Current condition customer electrical power demand is more but electrical power generation is not more. In this case use renewable energy sources for electrical power generation. In this paper renewable energy source is interface to electrical grid. Also improve power quality at point of common coupling. In this paper use FACT device STATCOM for interfacing purpose. STATCOM is static compensator. This STATCOM is control Icosϕ controller, which is generate control pulses and provide to STATCOM. It is maintain constant voltage and provide constant voltage to electrical grid.

KEYWORDS: Static compensator (STATCOM), Wind Energy Source (WES), Point of common coupling (PCC).

INTRODUCTION
As per today present condition electrical power generation is not more than customer demand. Customer demand is increases day by day because increases population day by day. Cost of electrical power generation is also more because sources (fuel, coal, oil, etc) are limited and costly. In this case we use renewable energy source like solar, wind, etc. Renewable energy source is many advantages. Output of renewable energy sources is variable. So it is not connected to directly in electrical grid[1].

In this paper use new novel ides and renewable energy source is connected to electrical grid. Using STATCOM to interface renewable energy source to electrical grid. STATCOM is static compensation which is shunt compensator. STATCOM is variable input is accepted from wind energy source and it is maintain constant voltage provide to electrical grid. STATCOM work with the help of Icosϕ controller. Icosϕ controller input to gives grid side and generate control pulse and provide output to STATCOM.

PROPOSED METHODOLOGY
Fig 1. Shows schematic diagram of proposed system. In this case three phase source is use and two non-linear loads is connected to system. First one single load is connected to system. As per customer demand after same time second load is connected to the system.

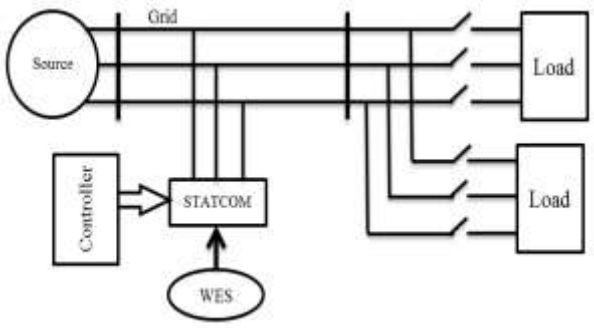

Fig 1. Schematic diagram of proposed system

STATCOM

STATCOM is static compensator which is shunt FACT device. Purpose of STATCOM is use for injection and absorption of reactive power. As compare to other FACT devices STATCOM is faster in operation, less size, less cost. Input of STATCOM is control pulse which is coming from controller and output of STATCOM is constant voltage which is providing to electrical grid[4].

Wind Energy Source

This paper we use renewable energy source as wind energy system. Output of wind energy source is not constant, because air is not flow continuously. Air is not continuous flow in wind blades then wind blades are not continuously rotate. So automatically wind turbine, generator speed is not constant. Induction generator is use because it is simply, accept variable output input

Available wind energy power is

$$P_{wind} = \frac{1}{2}\rho a V_{wind}^3 \quad (1)$$

V_w= Wind speed

$\rho = Air\ density$

A= Area of turbine blade

Kinetic energy of wind is not possible to extract. It is extract a fraction of power in wind called as power co-efficient of wind turbine.

$$P_m = C_p P_{wind} \quad (2)$$

Cp = Power Co-efficient

Put 1 in 2

$$P_m = \frac{1}{2} C_p \rho a V_{wind}^3 \quad (3)$$

Controller Circuit

In proposed system Icosϕ controller is use. Fig 2 show controller schematic diagram. In this controller input gives to voltage and current from grid sensor. After it is converted to control pulses and output to STATCOM circuit. In this case sinusoidal wave in phase with main voltage and generated by PLL[3].

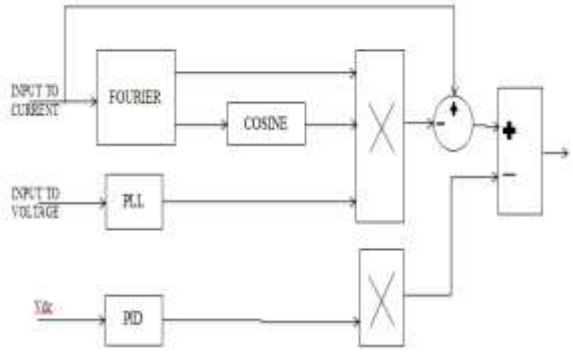

Fig. 2 controller schematic diagram

Fundamental active current and reactive current component is subtracting that should supplied by active power by inject compensating current.

$$I_L(t) = \sum_{n=1}^{N} i_{ln} \sin(n\omega t + \phi_n) \quad (4)$$

Where ω = fundamental angular frequency

i_{ln}= Peak value of nth harmonic current

ϕ_n= Phase angle of nth harmonic current.

Dividing $I_L(t)$ into three component

$$I_L(t) = i_{l1(p)}(t) + i_{l1(q)}(t) + i_{l(h)}(t)$$

It is

$$i_{l1(p)}(t) = i_{l1} cos\phi_1 \sin \omega t \quad (5)$$

$$i_{l1(q)}(t) = i_{l1} sin\phi_1 \cos \omega t \quad (6)$$

$$i_{l(h)}(t) = \sum_{n=2}^{N} i_{in} \sin(n\omega t + \phi_1) \quad (7)$$

5 is active fundamental component, 6 is reactive fundamental component, 7 is harmonic component. i_{l1},$\phi_1$and sinusoidal wave is multiplying, which is generated PLL gives active component.
Compensating current is

$$ic(t) = i_l(t) - i_{l1}(t) \quad (8)$$

8 depend upon the error signal. PID controller is determine the peak value of charging current Isc and required to be absorbed by APF.
Reference current of APF is

$$i_{ref}(t) = i_c(t) + i_{sc}(t) \quad (9)$$

SIMULATION RESULTS

In proposed system simulated in software MATLAB. 415V, 50Hz supply is use to source side and 25KW two load uses to load side. First condition one single 25KW load is activated after 0.2 sec second load is switched. Fig 3 shows source voltage waveform for R side. Which is sinusoidal.

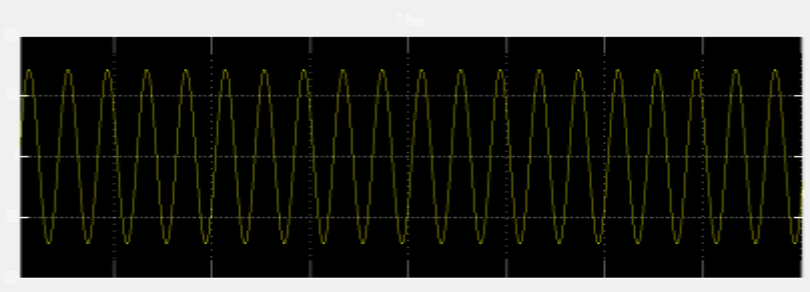

Fig 3. Source side Voltage Waveform

In first case STATCOM is disconnected in system and shows current performs in fig 4

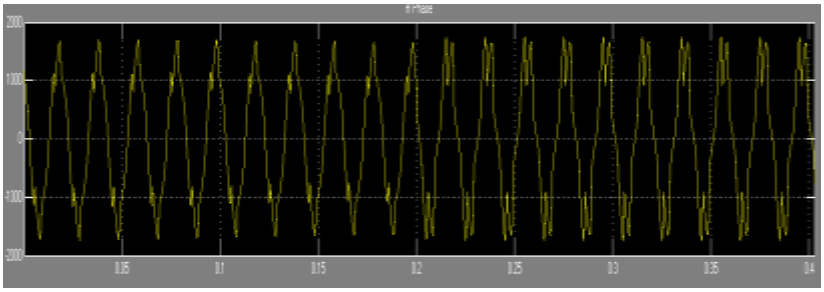

Fig 4. Source side current waveform without STATCOM

In second case STATCOM is connected in system and shows current performs in fig 5.

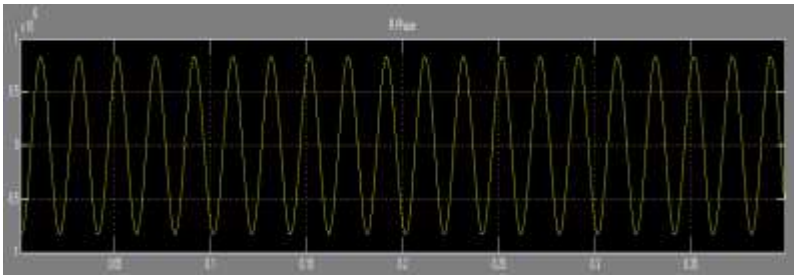

Fig 5. Source side current waveform with STATCOM

In fig 4 and fig 5 shows it is clear that load can be variable but STATCOM maintain the constant current profile. Fig 6 shows the output voltage of wind energy system, which is continuously variable. Wind energy system is connected to STATCOM and shows fig 7 is prove the constant output voltage.

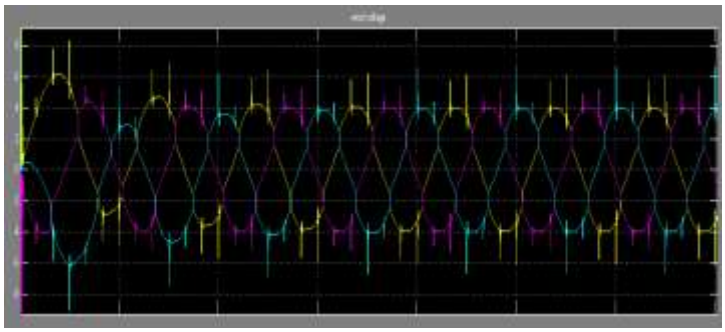

Fig 6. Wind Energy System Output Voltage

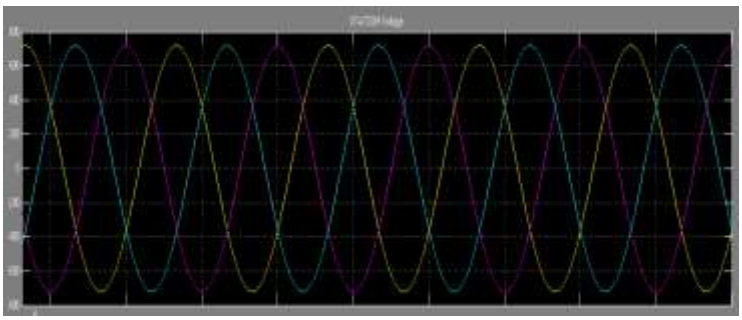

Fig 7. STATCOM Output Voltage Waveform

CONCLUSION

In this paper we improve power quality at grid point of common coupling and interface wind energy source to electrical grid using static compensator. STATCOM circuit, wind energy source, controller circuit is simulated and obtained various output results. To developed STATCOM Icosϕ controller and generated pulses. To maintain output of wind energy source and interface to electrical grid

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(I2OR), Publication Impact Factor: 3.785

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