# POWER QUALITY IMPROVEMENT OF USING STATCOM

**Mr. Shubham G. Tamse[1], Dr. S. B. Mohod[2]**

*[1]Student, Prof. Ram Meghe College of Engineering and Management, Badnera*
*[2]Professor, Prof. Ram Meghe College of Engineering and Management, Badnera*

---------------------------------------------------------------------***---------------------------------------------------------------------

**ABSTRACT :** Increased energy demand due to rapid industrialization, environmental concerns with fossil fuel-based generation, decreasing fossil energy resources, overloading of the transmission grids and deteriorating technical performance are the motivations for the integration of small decentralized renewable generation units (DG) and the conversion of existing energy. Optimizing the technical advantages of a DG placement is a well-known challenge for Distribution System Operators (DNOs) for DGs based on fossil and renewable energy resources, but renewable DG systems have several challenges in the network quality characteristic of renewable DG systems, as electricity loads react more sensitively to PQ disturbances and the penetration of renewable energies as well as non-linear loads, it spreads in the power distribution in grids. ) Technologies are becoming inevitable due to the ongoing reform in traditional distribution networks through the integration of renewable energies. This article contains a comprehensive analysis of the challenges of network quality in the network integration of renewable DG systems and the current state of research on corresponding mitigation techniques, theoretically emphasizes all the decisive challenges in network quality associated with the network integration of renewable energies, and, secondly, creates a matlab model of distribution line with STATCOM. Observing various fault and adding rectifier load on line with and without STATCOM we can conclude the benefit of STATCOM. The high penetration of renewable energies and techniques for reducing power quality are also demonstrated by the simulation of a grid-integrated PV-based DG system in MATLAB / Simulink. This article is believed to be very useful for academics and industry professionals to understand existing PQ challenges, PQI techniques, and future research guidelines for renewable energy technologies.

*Keyword: Solar photovoltaic, Wind energy, Hybrid PV-Wind system, STATCOM, Voltage stability.*

## INTRODUCTION

With urbanization, industrial enterprises and rising living standards, the unity of public services is affected by the increasing demand for electricity. The supply capacity of purely typical sources cannot meet the demand for modern energy, thus increasing the difficulty of the reliability and security of the electricity supply, while the large amount of pollutants poses serious environmental problems. 20 years ago renewable and decentralized energy sources emerged as a supplement to standard energy sources and the unit range predicted by utility engineers as a powerful solution to successfully meeting load demand Hybrid Renewable Energy (HRES), which is primarily based on distributed generation (DG), is the recent trend in the renewable energy system because it has been shown to improve performance and accountability . Various possibilities are argued for using many renewable energies efficiently. Sources for generating electricity. Renewable energy sources, wind and alternative energy sources are quickly used in combination in various hybrid systems. Recently, hybrid photovoltaic wind-star systems received important attention from energy providers around the world. Power analysis of the hybrid energy system of the wind-electric phenomenon, which is connected to the grid via an electronic power interface. In order to obtain an additional sensitive state, a variable AC load within the system is used together with intermittent power sources from the photovoltaic star system and WEC in a test to bring a strong dynamic into the hybrid system. The primary result of this is that a variable reactive power supply is required to maintain a voltage profile on the load bus.Under these circumstances, STATCOM represents an alternative to the device as it has been proven in many studies that it improves voltage regulation in isolated hybrid systems. Additional modeling system as the simulation has misused MATLAB / Simulink 2019 to evaluate the performance and the functionality to check the hybrid system connected to the network in isolated systems and to demonstrate the suitability of STATCOM with regard to increasing the voltage properties of the load rail.

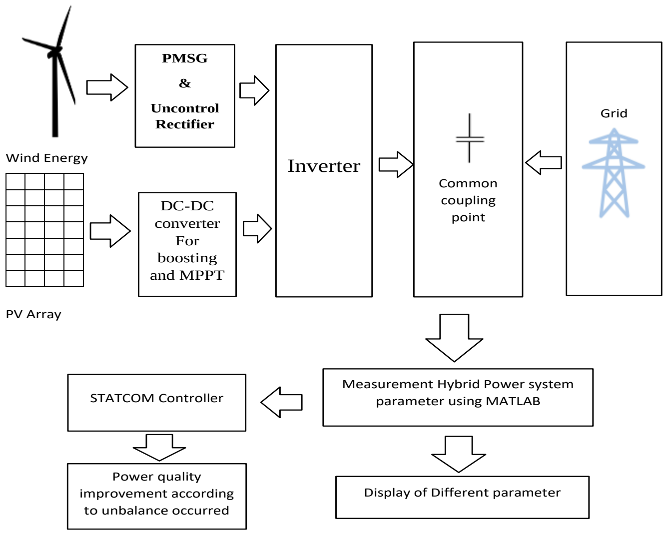


Fig 1 .: Configuration of the renewable photovoltaic wind hybrid system connected to a distribution network compensated by STATCOM

The systems are increasingly burdened with electricity requirements The supply of the systems from purely conventional sources cannot cover modern energy requirements and thus increases the difficulty of energy reliability and security, while the large number of pollutants raises serious environmental problems [1,2]. Over the past 20 years, renewable and distributed energy sources have emerged to complement standard energy sources and are viewed by utility engineers as a powerful solution for meeting load needs to successfully overcome problems. Decentralized Generation (DG) based on Hybrid Renewable Energy Systems (HRES) is the recent trend within the renewable energy system as it has been shown to improve overall performance and reliability [5] sources for power generation [6]. Among all the trending renewable energy sources, combined wind and solar energy sources are used efficiently in various hybrid systems. Recently, solar-photovoltaic-wind hybrid systems have received a lot of attention from utility companies around the world [7,8]. and solar systems complement each other in the daily cycle. Solar energy, which has the potential to meet four times the total global energy demand in a given region of North Africa [9], is available throughout the day, while strong winds occur mainly at night. In general, strong winds are observed in the course of darkness and also on cloudy days as opposed to weak winds on bright days [10]. Regardless of their intermittent behavior and inherent disadvantages, hybrid wind-photovoltaic energy systems tend to provide energy for charging with greater reliability and continuity of supply [11,12]. Despite the ability to provide power with improved continuity and reliability, the volatility of such intermittent power sources has a direct impact on the critical stability between the power supply from renewable energy sources and thus the connected load [13]. As a result, deviations from bus voltage and network frequency, network interval fluctuations and excess reactive power generation are again determined by the moving network stability and network quality [14]. From energy physics science technology and the associated versatile A. transmission devices (FACTS) [15], the devices indicate their possible applications in such renewable energy sources (RES) in order to reduce problems with network quality. Various devices are used and studied on the market and they give satisfactory results [16]. Of many devices, SVC and STATCOM are said to be best suited for reagent performance compensation and voltage maintenance support [24]. SVCs often increase the disadvantage of capacity quality in isolated hybrid systems [25, 26] that support reactive power management. However, as a mainly VSC-based device, STATCOM shows a higher performance compared to SVC if one takes into account the variation and identical evaluations [27,28].Mohanty et al. [29] transferred the advantages of the genetic algorithm (GA) and the Particle Swarm Optimization (PSO), the optimized implementation of STATCOM in an offshore wind-diesel-tidal-rotary engine hybrid system. The hybrid system was established by adopting the tiny signal model. The power compensation is achieved by combining the STATCOM controller. Shanthiet al. [30], an undeniably economical energy transmission structure for wind-photovoltaic hybrids, which can be implemented with a minimal variety of converters wherever a network aspect device for WEC such as STATCOM is used to increase the network dynamics. Mohanty et al. [31] have described numerous problems in connection with poor transient stability in an autonomous wind / diesel / photovoltaic hybrid system and transferred the influence of UPFC, SVC and STATCOM in suppressing the dynamics of the hybrid system. The careful comparison could not hide the fact that STATCOM has superior properties compared to the typical PI controller. SVC based on the simulation study by Bhatti et al.[32] examined the effects of STATCOM on bus voltage management in a stand-alone wind-diesel hybrid by compensating for the immunoglobulin reactive power demand and variable load, thereby maintaining system stability once a mod is delivered at speed. Reactive load and wind speed SOLAR-PV-MPPT-MANAGEMENT-TECHNIK In order to use the largest part of the energy of a photovoltaic system, it is necessary that the associated influence of the DC electronics take into account the bus voltage at the output for such a heterogeneous purpose in which the most performance units are sometimes This electrical device is nothing more than an associated MPPT controller that is inserted between the photovoltaic system and the payload.

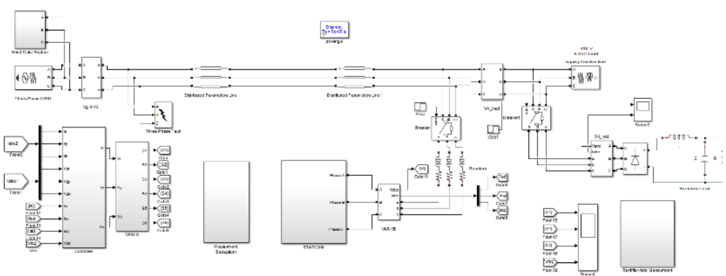

Figure 2 Distributed line with STATCOM

In this work the final model is created taking into account two cases, in the first case the distributed line is created with STATCOM. In this model, the AC load is connected on the receiving side, and a rectifier load is added for the addition of harmonics.It occurs for a reasonable time and also the disturbances with the help of three-phase faults that push the system to 0. 8 sec. to 1.2 sec. Figure 2 above describes the Statcom model.

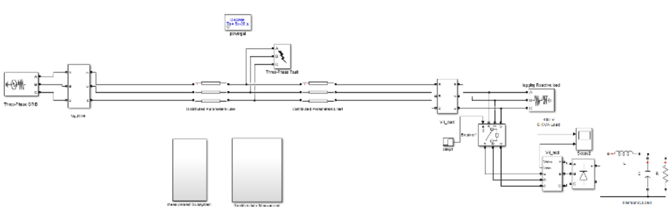

Figure 3 Distribution line without STATCOM

Figure 3 shows the distribution line without STATCOM, in this model only the AC load is connected on the receiving side and the rectifier load is connected in order to generate harmonics in the line. Here I also considered case 2, case 1 is B. when grinding the load is applied online to generate harmonics for more than 0.5 seconds and in case 2 multiple errors are applied online for a period of 0.8 seconds to 1.2 second.

**RESULT**

A) Result for with STATCOM model

**Case 1: only rectifier load for harmonics generation**

In case 1 model is run with AC Load containing harmonics above 1.2 sec, this harmonic is negligible by using statcom. also, at after 0.8 sec fault is occur on line the effect of fault on line is less as compare to without STATCOM model.

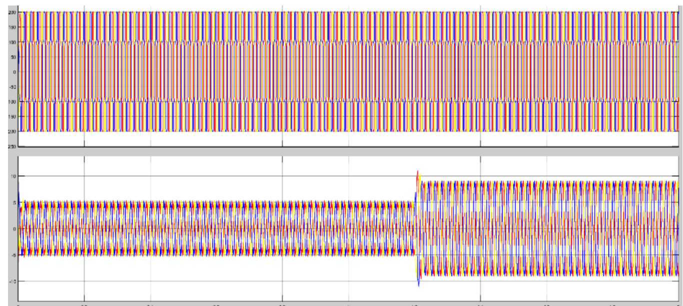

fig: 4 model with harmonics at source

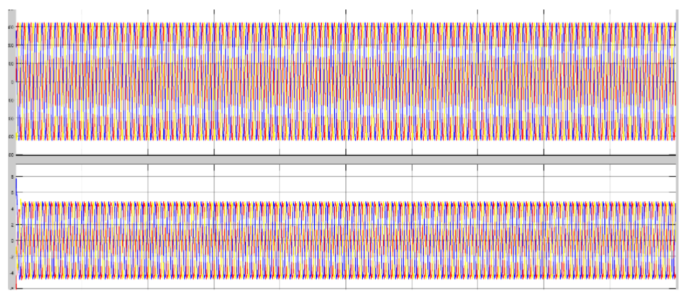

fig:5 model with harmonics at load

case 2 : fault at load side with STATCOM

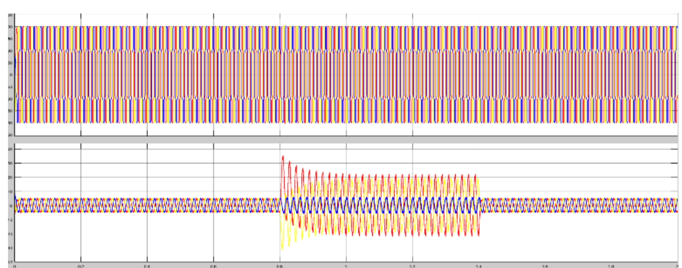

Fig.6 LLG fault on load side

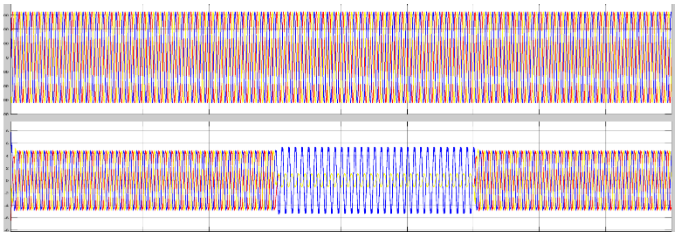

fig.7 LG fault on load side

B) Result for with STATCOM model

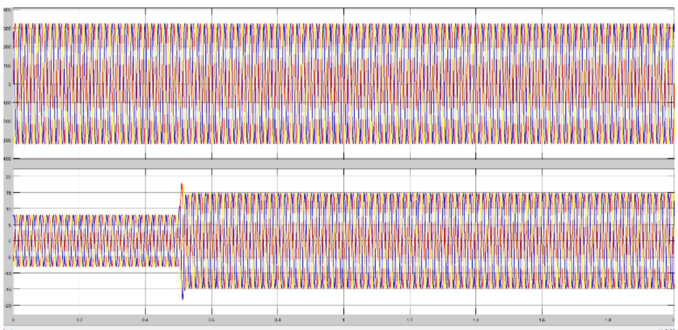

Fig 8 model with harmonics at source

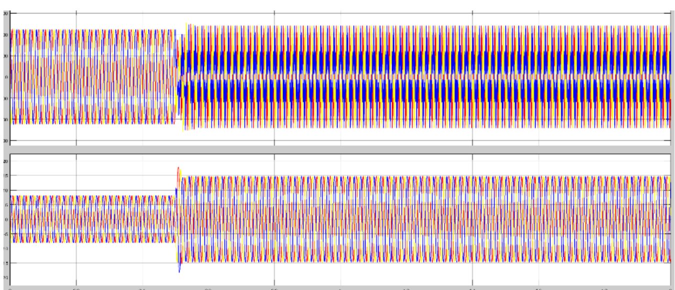

fig:9 model with harmonics at load

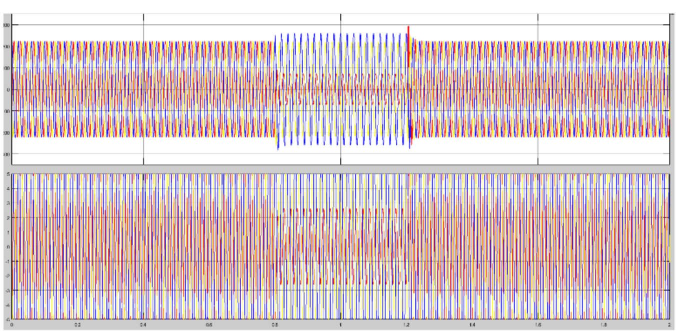

Fig.10 model with LG fault on source

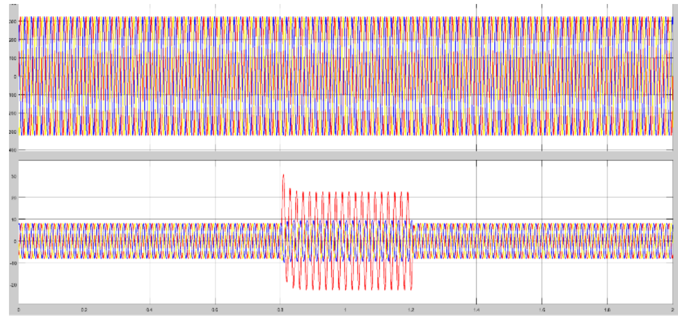

fig.11 model with LG fault on load

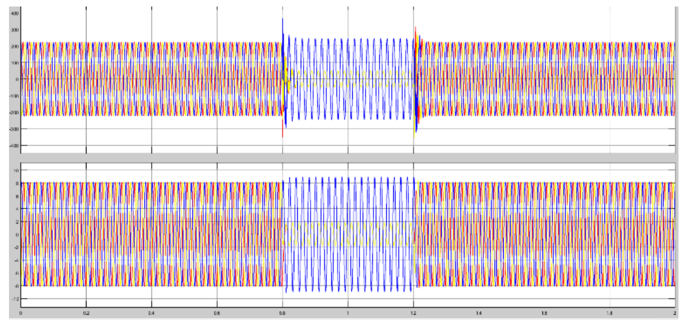

Fig.12 model with LLG fault on source

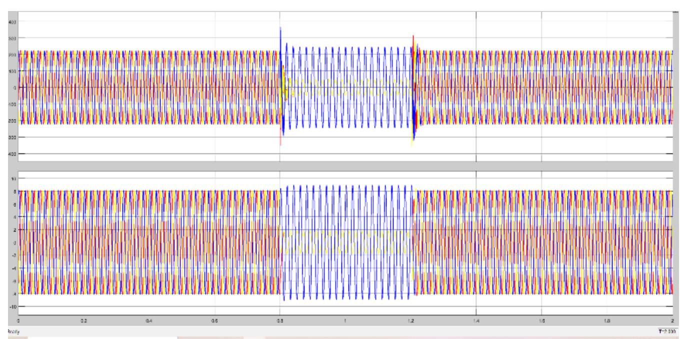

fig.13 model with LLG fault on load

By considering and studying above fault and harmonics, in this by using STATCOM the effect of fault and harmonics on load can be neglected or reduced.

**CONCLUSION**

In this article, the potential influence of STATCOM in associated grid-connected hybrid-star-solar-PV system environments was examined under different load conditions. 3 completely different eventualities were developed to evaluate the effectiveness of STATCOM in strengthening voltage regulation. The measurement must first be carried out for the transitional responses received in each case. The results obtained showed that the voltage profile is successfully maintained in the presence of

STATCOM, which effectively counteracts a greater flow of reactive energy on the road and suppresses its undesirable effects. the performance of the system Hence a unit of conclusion generally drawn from the simulation result, it was found that the STATCOM has the ability to stabilize the voltage on the connection bus by compensating for the reactive power and could give a shocking answer to the energy suppliers to the event of the performance and responsibility of this This work thought of purely linear clusters, either strictly resistive or inductive for easy simulation. However, these clusters are rarely found in energy systems. Common sense, for the most part, encompasses heaps of inductive and nonlinear motors, all of which add system disturbances in terms of current imbalance and harmonic injections. In the future, this work could even be expanded by implementing these intelligent stacks in networked hybrid RES environments to review their effects on system dynamics and to examine the diverse potential of different FACTS controllers to perform different functions.

**REFERENCES**

1)Khare V, Nema S, Baredar P. Solar-wind hybrid renewable energy system: a review. Renewable Sustainable Energy Rev 2016;58:23–33. https://doi.org/10.1016/j.rser. 2015.12.223.

2)Jamil B, Siddiqui AT, Akhtar N. Estimation of solar radiation and optimum tilt angles for south-facing surfaces in Humid Subtropical Climatic Region of India. Eng Sci Technol an Int J 2016;19:1826–35. https://doi.org/10.1016/j.jestch.2016.10. 004.

3)Gandoman FH, Ahmadi A, Sharaf AM, Siano P, Pou J, Hredzak B, et al. Review of FACTS technologies and applications for power quality in smart grids with renew- able energy systems. Renewable Sustainable Energy Rev 2018;82:502–14. https:// doi.org/10.1016/j.rser.2017.09.062.

4)Jamil E, Qurratulain, Hameed S. STATCOM-based voltage regulation in grid in- tegrated wind farm under variable loading conditions. 2017 14th IEEE India Counc. Int. Conf. 2017. p. 1–6. https://doi.org/10.1109/INDICON.2017.8488062.

5)Sinha S, Chandel SS. Improving the reliability of photovoltaic-based hybrid power system with battery storage in low wind locations. Sustainable Energy Technol Assess 2017;19:146–59. https://doi.org/10.1016/j.seta.2017.01.008.

6) Maatallah T, Ghodhbane N, Ben Nasrallah S. Assessment viability for hybrid energy system (PV/wind/diesel) with storage in the northernmost city in Africa, Bizerte, Tunisia. Renewable Sustainble Energy Rev 2016;59:1639–52. https://doi.org/10. 1016/j.rser.2016.01.076.

7)Phap VM, Yamamura N, Ishida M, Hirai J, Nga NT. Design of novel grid-tied solar- wind hybrid power plant using photovoltaic cell emulating system. 2016 IEEE Int Conf. Sustain. Energy Technol. 2016. p. 186–9. https://doi.org/10.1109/ICSET. 2016.7811779.

8)Sharma B, Dahiya R, Nakka J. Effective grid connected power injection scheme using multilevel inverter based hybrid wind solar energy conversion system. Electr Power Syst Res 2019;171:1–14. https://doi.org/10.1016/j.epsr.2019.01.044.

9)Bailek N, Bouchouicha K, Aoun N, EL-Shimy M, Jamil B, Mostafaeipour A. Optimized fixed tilt for incident solar energy maximization on flat surfaces located in the Algerian Big South. Sustainable Energy Technol Assess 2018;28:96–102.

10)Khan MJ, Yadav AK, Mathew L. Techno economic feasibility analysis of different combinations of PV-Wind-Diesel-Battery hybrid system for telecommunication ap- plications in different cities of Punjab, India. Renewable Sustainable Energy Rev 2017;76:577–607. https://doi.org/10.1016/j.rser.2017.03.076.

11)Rini TH, Razzak MA. Voltage and power regulation in a solar-wind hybrid energy system. 2015 IEEE Int. WIE Conf. Electr. Comput. Eng. 2015. p. 231–4. https://doi. org/10.1109/WIECON-ECE.2015.7443904.

12)Wang L, Lin T. Stability and performance of an autonomous hybrid wind-PV-battery system. 2007 Int. Conf Intell. Syst. Appl. to Power Syst. 2007. p. 1–6. https://doi. org/10.1109/ISAP.2007.4441622.

13)Olamaei J, Ebrahimi S, Moghassemi A. Compensation of voltage sag caused by partial shading in grid-connected PV system through the three-level SVM inverter. Sustainable Energy Technol Assess 2016;18:107–18. https://doi.org/10.1016/j. seta.2016.10.001.

14)IEA. Global energy demand rose by 2.3% in 2018, its fastest pace in the last decade. International Energy Agency (IEA), < https://www.iea.org/newsroom/news/ 2019/march/global-energy-demand-rose-by-23-in-2018-its-fastest-pace-in-the-last- decade.html > ; 2019 n.d. https://doi.org/10.1016/j.seta.2017.05.004.

15)Hingorani NG, Gyugyi L. Understanding FACTS: Concepts and Technology of Flexible AC Transmission

Systems. New York, NY: USA Wiley-IEEE Press; 2000. p. 1–6.

16)Mohammadpour HA, Ghaderi A, Mohammadpour H, Ali MH. Low voltage ride- through enhancement of fixed-speed wind farms using series FACTS controllers. Sustainable Energy Technol Assess 2015;9:12–21. https://doi.org/10.1016/j.seta. 2014.10.007.

17)Basaran K, Cetin NS, Borekci S. Energy management for on-grid and off-grid wind/ PV and battery hybrid systems. IET Renewable Power Gener 2017;11:642–9. https://doi.org/10.1049/iet-rpg.2016.0545.

18)Jamil E, Ahmad S, Khan MH, Afzal M. Dynamic modeling of regulated solar PV- wind hybrid system for off-grid applications. 2017 Int Conf Energy, Commun Data Anal Soft Comput. 2017. p. 3221–6.

19)Philip J, Jain C, Kant K, Singh B, Mishra S, Chandra A, et al. Control and im- plementation of a standalone solar photovoltaic hybrid system. IEEE Trans Ind Appl