

POWER QUALITY IMPROVEMENT TECHNIQUES IN HYBRID SYSTEMS – A REVIEW

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Abstract-Power Quality is one of a major constraint in power system transmission and distribution. Now a day's most of the energy was consumed by us. The abnormal growth of Electric Energy consumers, power demand is also being increased. At the same time the unavailability of fossil fuels and the cost of generation, transmission and utilization are increased. Hence, the power producer opposes to reduce the cost of power generation. Simultaneously the consumer thinks about that, to get good quality of power and to minimize the power tariff. To meet the both ends we go for hybrid power generation system. To implement Hybrid power system, it has several problems such as Protection, Synchronization, Power Quality, etc., in this paper we focused on various methods of power quality improvement Techniques in hybrid power systems.

Key words: WT, CHP, PQ, PV system, THD, Fuel cell

I. INTRODUCTION

Hybrid power system is a combination of renewable energy technologies. India is becoming one of the developing countries in this world. The developing growth of the population and the increasing amount of energy conservation are the key factors. To prevent consumers from lagging of power and to meet their demands, hybrid system is an exact solution. These resources are going to connect in to the National grid or utility grid. It operates in two modes. They are Island mode and Grid connected mode.

The generation of power is very low when compared to utility grid. Hence, it is connected in small units. If there is no power required it was connected to the utility grids. During the combination or grid integration there are many problems rising like Synchronization, Power Quality and Protection, Load sharing etc... In this paper focused a review on Power Quality Mitigation Techniques in Hybrid Systems.

II.LITERATURE SURVEY

Power quality are long duration voltage variations (overvoltage, under voltage, and sustained interruptions), short duration voltage variations (interruption, sags (dips), and swells), voltage imbalance, waveform distortion (DC offset, harmonics, inter harmonics, notching and noise), voltage fluctuation (voltage flicker) and power frequency variations.

Most reasons of these concerns stems from loads connected to electric supply systems [1], [2].

Measurements for active filter as well as the behavior of inverter systems with UPS functionality during grid faults where discussed at the end of utility side. Under without APF the total harmonic distortion is 32.8% and by using APF in a DG unit the THD is reduced around 10.2% in non linear loads. By using series APF, the THD value almost reduced to 9.5% [3]. It improves the controlling of excitation and input power of a synchronous generator. PID Controller is used in a generator governor control in frequency of a system. By using Bacteria foraging optimization technique to optimize, the PID controller gain is used to improve the PQ with the help of MATLAB [4]. Photo voltaic – Fuel cell combination system comprises a PV Panel. A battery bank was connected to the DC bus. Power flow is present in two way of the battery if it is present in charged condition the fuel cell will be turned off. In this case the battery supplies the power to the load. It was verified by Virtual Test Bed (VTB) [5].

A technical review of power quality problems and how the custom devices used to improve the PQ in grid connected renewable energy systems at the point of Common Coupling were discussed [6]. The performance analysis of a shunt active filters with VSI Topology using synchronous frame theory in grid connected PV Panel were discussed. It reduced the harmonic level at the point of common coupling for 3.94% by using shunt active filters [7]. From This study was describes the detailed analysis of different control strategies for a standalone wind energy conversion system using induction generator and It was simulated by MATLAB [8]. An adequate

control strategy with a simple three-leg four-wire system is possible to mitigate the power quality disturbances like voltage unbalance, THD and others [9].

The comparative study of two PWM controller techniques is briefly discussed. The current harmonic controls and reactive power compensation was done by using converter as an active shunt filter and the other converter is used to control the voltage sag and swell also it describes about the cost analysis of PV systems [10].

The existence of the PQ problems due to the installation of wind turbines with the grid is expressed. To implement FACT Control device at a point of Common Coupling with Battery Energy Storage System, the THD reduced to 4.96% with control instead of 12.53% for without control. With the implementation of controllers it reduced again 0.4 %. The output was verified through the help of MATLAB [11]. It develops a high efficiency of power controllers. That optimizes energy extraction from the hybrid system. A single micro controller is used to control both voltage and current sources. The output was verified by P - Q Theory using MATLAB [12].

Wind – Diesel hybrid system was proposed and the Modified Elman Neural Network (MENN) is used to determine. It reduced the THD. By varying the pitch angle the THD value is to reduce 2.92. The output was verified with the help of MATLAB [13]. Modelling and design of a PWM – VSI was connected between sources, which supplies energy to the grid. The test was conducted at the point of load side and source side with closed loop and open loop test with the help of MATLAB [14].

The issues on fixed pitch wind turbine coupled with Induction Generator were discussed[15]. Disturbance of PQ was measured by varying the X/R ratio at the point of pitch angle in a wind turbine also the output was verified by MATLAB. While implementing wind turbine with Diesel power generation the frequency was affected and it has been measured along with its effects on how it could disturb the PQ Phenomena in a system [16]. Fuel cell and Electrolyzer system are defined by the first order transfer function.

The tie line power and the output change of micro turbine by the frequency fluctuation are presented[17], and it demonstrates the effectiveness of the dynamic control method. PI regulators are used to compensate the power changes in Micro Grid power system and tie line.

Table 1 shows the model design parameters for micro grids. Table-I

MICROGRID MODEL PARAMETERS					
ES	P_{ES}^{min}	50kW	FC	P_{FC}^{min}	5kW
	P_{ES}^{max}	70kW		P_{FC}^{max}	5kW
	P_{ES}^{min}	30kW		P_{FC}^{min}	2kW
	K_{ES}	100		K_{FC}	—
	T_{ES}	60		T_{FC}	—
MT	P_{MT}^{min}	70kW	WP	P_{WP}^{min}	15kW
	P_{MT}^{max}	100kW		P_{WP}^{max}	100kW
	P_{MT}^{min}	10kW	PV	P_{PV}^{min}	10kW
	K_{MT}	0.04		P_{PV}^{max}	25kW
	M	10	Tie line	X_{tie}	0.072
	D	1		System	f_0
Housing	$P_{Housing}^{min}$	50kW			$Base$

[18] Active Power Conditioner (APC) acts as to interface between renewable energy sources and the AC bus of micro grid. Extended Indirect Control Strategy is capable to achieve better values for the following power quality indicators: THD (Total Harmonic Distortion), PF (Power Factor), current and voltage balancing. It was verified by MATLAB.

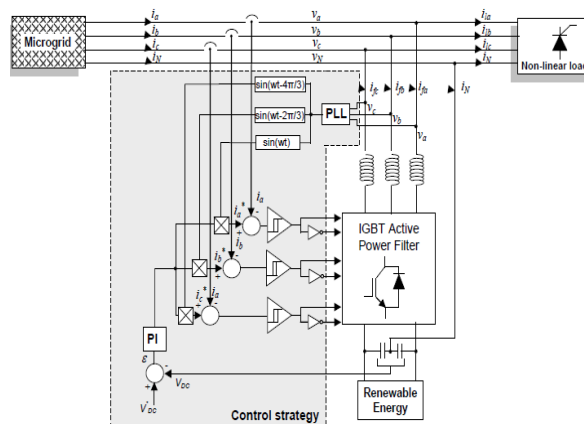


Figure -1 Simulation diagram for load control

Battery storage provides a rapid response for either charging/discharging the battery and also acts as a constant voltage source for the critical load in the distributed network [19, 20]. The comparative analysis of PQ controllers is discussed in mathematical model and simulated. From the performance analysis concludes SVC Type II controller is best controller for wind diesel hybrid power system [21].

SVC Controller is used to eliminate the mismatch of supply and demand of reactive power in wind diesel hybrid system under varying conditions of load and the input of wind power. ANN models have been developed for variable slip/speed wind-diesel autonomous hybrid power system configurations for tuning the proportional-integral controller of SVC [22]. The start-up of the wind turbine and the transient condition during load changes affect voltage and frequency in the system [23]. Approximately 70% to 80% of power quality related problems can be attributed to faulty connection and wiring [24].

- [18] GeluGurguiatuIonelVechiu and ToaderMunteanu," Power quality improvement using renewable energy" www.google.com Dated: 20.07.2013
- [19] B. S. Borowy and Z. M. Salameh, "Dynamic response to a stand-alone wind energy conversion system with battery energy storage to a wind gust," IEEE Trans. Energy Convers., vol. 12, no. 1, pp. 73–78, Mar. 1997.
- [20] W. SharadMohod, Member, IEEE, and Mohan V. Aware"Micro wind power generation with battery energy storage for critical load" IEEE Systems Journal, vol. 6, no. 1, March 2012.
- [21] R. C. Bansal," Automatic Reactive-Power Control of Isolated Wind–Diesel Hybrid Power Systems" IEEE Transactions on Industrial Electronics, August 2006.
- [22] R. C. Bansal, T.S. Bhatti, V. Kumar," Reactive Power Control of Autonomous Wind- Diesel Hybrid Power Systems Using ANN" The 8th International Power Engineering Conference (IPEC 2007).
- [23] E. Muljadi and H.E. McKenna" Power Quality Issues in a Hybrid Power System" IEEE—IAS 2001 ConferenceChicago, IllinoisSeptember 30, 2001—October 4, 2001.
- [24] C.Sankaran"PowerQuality"CRC Press 2002.
- [25] www.photonenergy.com Dated: 15.07.2013
- [26] H. Suzuki, M. Takeda, G. Reed, "Application of Voltage Source Converter Technology to a Back-to-Back DC Link," Presented at the Panel Session on FACTS Controllers: Applications and Operational Experience, IEEE PES Summer Power Meeting, Edmonton, Alberta, July 1999.
- [27] S. G. Dan, D. D. Benjamin, R. Magureanu, L. Asiminoaei,R. Teodorescu and F. Blaabjerg, "Control strategies of active filters in the context of power conditioning", European Conference on Power Electronics and Applications, 2005.
- [28] M.E. Meral,A.Teke, K.C.Bayindir, M Tumay "Power Quality Improvement with an Extended Custom Power Park" Int.J.Electric Power System Research – 2009.
- [29] H.H.Zeineldin and A.F.Zoba "Particle Swarm Optimization of passive filters for Industrial Plants in Distributed Network" Electric power components and systems, ISSN: 1532 – 5008,2011.
- [30] M.E.Meral,A.Teke,K.C.Bayindir, M.Tumay "Power Quality Improvement with an Extended Custom Power Partk" Electric Power System Research, 2009.
- [31] S.M.Muyeen, R.Takohashi, T.Murata, J.Jamura, M.Hassan Ali. "Application of statcom/BESS for wind power smoothening and hydrogen generation" Electric Power System Research, 2009.
- [32] C.K.Sundarabalan,P.Sathishbabu, "Unified Power Quality Controller for Enhancement of power quality and hybrid power generation injection to grid distribution system" Int.J.of Modern Engineering Research, Apr 2012, ISSN: 2249 – 6645.