ENERGY MANAGEMENT SYSTEM BASED ON LANDSMAN CONVERTER FOR MICROGRID USING HYBRID ENERGY SOURCES

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Abstract: This paper presents a control of a micro-grid at an isolated location fed from wind and solar based hybrid energy sources. The machine utilized for wind vitality transformation is doubly fed induction generator (DFIG) and a battery bank is associated with a typical DC transport of them. A solar photovoltaic (PV) array is used to convert solar power, which is evacuated at the common DC bus of DFIG using a DC-DC Landsman converter in a cost effective way. It alters the frequency set point based on the energy level of the battery, which slows down over charging or discharging of the battery. The framework is additionally ready to work when wind control source is unavailable. It is high efficient and noiseless operation. A simulation results are presented for various conditions.

Keywords- DFIG, PV panel, Fuzzy logic control,WECS,Simulink/Matlab.

I.INTRODUCTION

This paper presents a control of a micro-grid at an isolated location fed from wind and solar based hybrid energy sources. The machine used for wind energy conversion is doubly fed induction generator (DFIG) and a battery bank is connected to a common DC bus of them[1]. A solar photovoltaic (PV) array is used to convert solar power, which is evacuated at the common DC bus of DFIG using a DC-DC boost converter in a cost effective way. The voltage and frequency are controlled through an aberrant vector control of the line side converter, which is joined with hang attributes. It alters the frequency set point based on the energy level of the battery, which slows down over charging or discharging of the battery. system is implemented using a 5 kW solar PV array simulator and a 3.7 kW wound rotor induction machine[1] and experimental results are produced to reaffirm the theoretical model and design. Loads and intermediate storage units that co-operate with each other to be collectively treated by the grid as a controllable load or generator. Power quality events and pre-set conditions will make the microgrid disconnect from the main grid and operate as a separate island [2].

In this paper, the enduring state and transient task of a run of the mill microgrid are studied. The models of two scattered age units (photovoltaic framework, wind turbine) are displayed. Models of the power electronics interface and control strategies for fast control of frequency and voltage magnitude without communication are derived [3]. This paper concentrates on the design and analysis of a controller for multibus microgrid system. The controller proposed for use with each distributed generation (DG) system in the microgrid contains inner voltage and current loops for regulating the three-phase grid-interfacing [4]inverter, and outside power control circles for controlling genuine and receptive power stream and for encouraging force sharing between the paralleled DG frameworks when an utility fault occurs and the microgrid islands. The controller likewise joins synchronization calculations for ensuring smooth and safe reconnection of the miniaturized scale and utility lattices when the fault is cleared[4]. Joining of wind turbines and photovoltaic frameworks with lattice prompts matrix unsteadiness. One of the solutions to this problem can be achieved by the implementation of microgrid. Even though there are several advantages associated with microgrid operation, there are high transmission line losses[12]. In a microgrid there are several units which can be utilized in a house or countryDuring fault in the utility grid microgrid operates in islanded mode. If in any case [12] renewable source can't supply enough power and state of charge of storage devices are low microgrid disconnects common loads and supply power to the sensitive loads.

II.PROPOSED METHODOLOGY

A. Block Diagram Of Proposed System

The solar panel and wind energy conversion systems (WECS) are the input sources. The WECS having the Pulse Width Modulation rectifier and the solar panel having the Landsman converter are connected to the input DC line. The PWM generator is used to giving the gate pulse to the landsman converter and three-phase voltage source inverter. The three-phase voltage source inverter is used to convert the DC-AC supply to the load. The grid synchronization is achieved using hysteresis current controller.

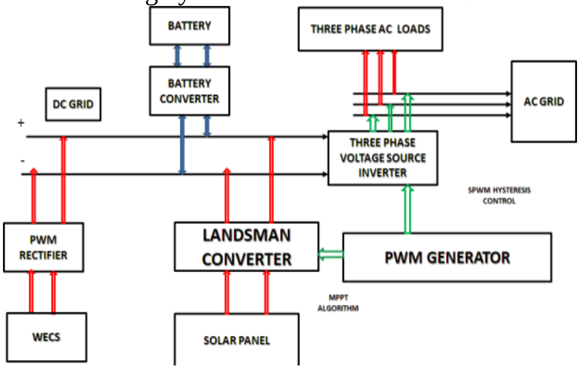


Figure 1: Block diagram of proposed system

B. *Circuit Diagram For Proposed System*

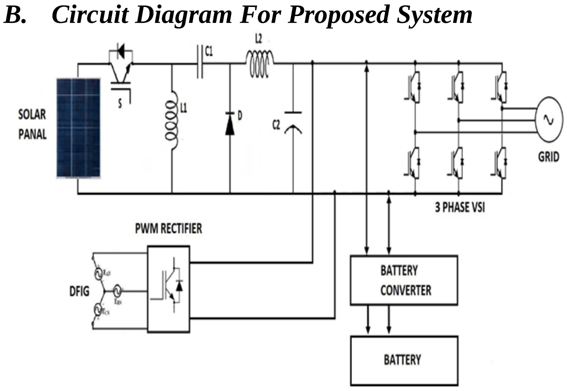


Figure 2: Circuit diagram of proposed system

In the proposed system, PV arrays are connected to the DC bus through boost converter to simulate DC sources. A DFIG wind generation system is connected to AC bus to simulate AC sources. A battery with bidirectional DC/DC converter is connected to DC bus as energy storage. A variable DC and AC load are connected to their DC and AC buses to simulate various loads.

C. *Landsman Converter*

A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of Direct Current (DC) from one voltage level to another. It is a type of electric power converter.It having higher efficiency and noiseless operation.

Modelling Of Landsman Converter: The role of the main converter is to exchange power between AC and DC bus. The key purpose of main converter is to maintain a stable DC-link voltage in grid tied mode. When the converter operates in grid tied mode, it has to supply a given active and reactive power. Here PQ control scheme is used for the control of main converter. The PQ control is achieved using a current controlled voltage source. Two PI controllers are used for real and reactive power control. When resource conditions or load capacities change, the DC bus voltage is settled to constant through PI regulation. The PI controller is set as the instantaneous active Current reference and the instantaneous reactive current in-reference are determined by reactive power compensation command.

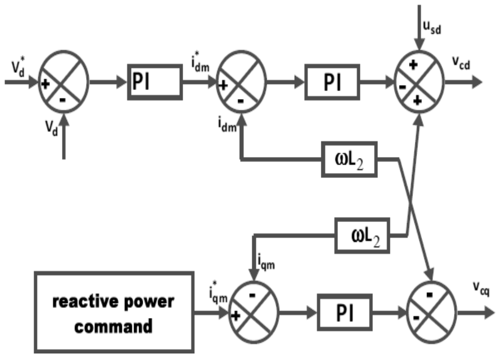


Figure 3: Control block diagram of Landsman converter

D. *Hybrid Electric System*

Solar and wind hybrid power systems are designed using solar panels and small wind turbine generators for generating electricity. Generally, these are capable of small capabilities. The thypical power generation capacities of solar-wind hybrid systems are in the range from 1kw to 10kw.

Solar Panel: PV modules are connected in series and parallel. As solar radiation level and ambient temperature changes the output power of the solar panel alters. A capacitor C is added to the PV terminal in order to suppress high frequency ripples of the PV output voltage.

Doubly Fed Induction Generator: A doubly fed induction generator (DFIG) is an Induction Motor with a wound rotor where the rotor and stator are both connected to electrical source, hence the term 'doubly-fed'. A wind generation system consists of doubly fed induction generator (DFIG) with back to back AC/DC/AC PWM converter connected between the rotor through slip rings and AC bus.

Bidirectional Converter: The bidirectional DC/DC converter is designed to maintain the stable DC bus voltage through charging or discharging the battery when the system operates in the autonomous operation mode. The battery plays very important role for both power balance and voltage stability. The battery converter is also called the bidirectional converter.

E. *Fuzzy Logic Controller*

Fuzzy logic expressed operational laws in linguistics terms instead of mathematical equations. Many systems are too complex to model accurately, even with complex mathematical equations; therefore traditional methods become infeasible in these systems. However fuzzy logics linguistic terms provide a feasible method for defining the operational characteristics of such system. Fuzzy logic controller can be considered as a special class of symbolic controller.

The fuzzy logic controller has three main components,

- Fuzzification
- Fuzzy inference
- Defuzzification

V. SIMULATION AND RESULTS

Simulation Diagram

A hybrid microgrid is simulated using MATLAB/SIMULINK environment. The operation is carried out for the grid connected mode. Along with the hybrid microgrid, the performance of the doubly fed induction generator, photovoltaic system is analyzed. The solar irradiation, cell temperature and wind speed are also taken into consideration for the study of hybrid microgrid. The performance analysis is done using simulated results which are found using MATLAB.

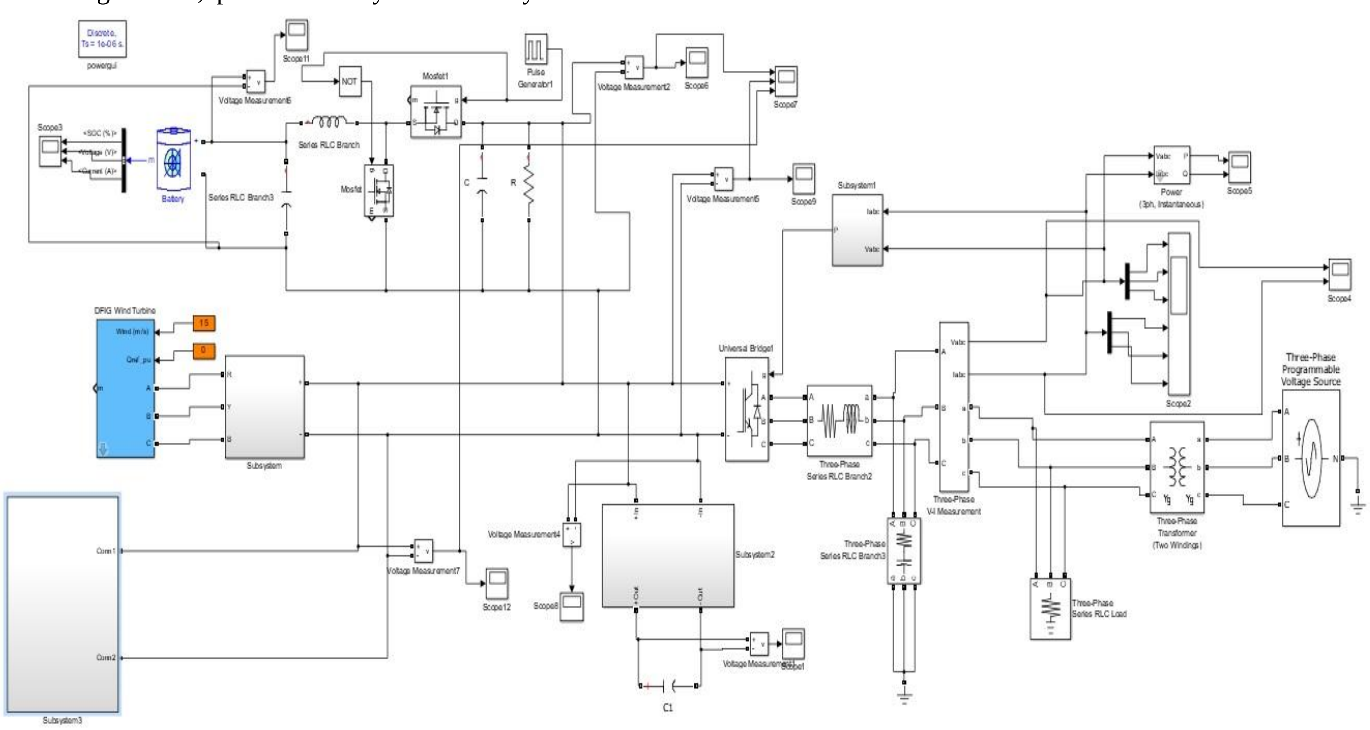


Figure 4 Proposed system simulation diagram

i)Solar Panel Output Wave Form

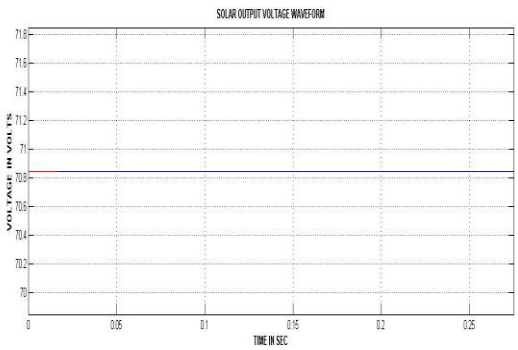


Figure 4.1: Solar panel output voltage waveform

i) Landsman Converter Input & Output Waveform

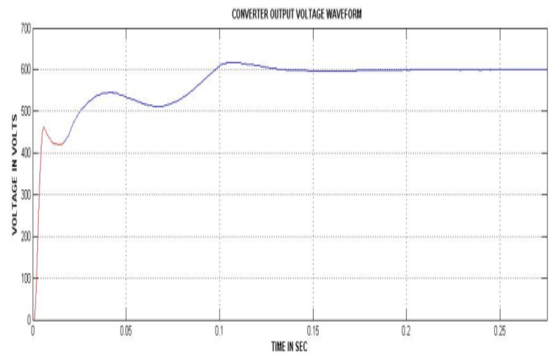


Figure 4.2: Landsman converter output voltage waveform

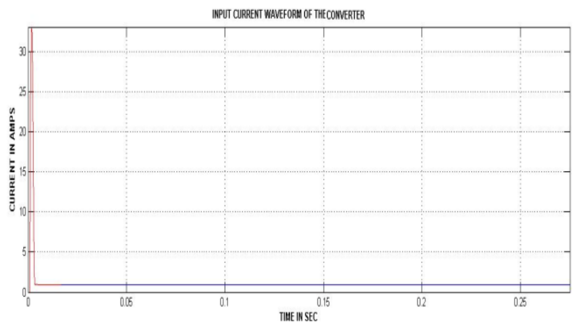


Figure 4.3: Landsman converter input current waveform

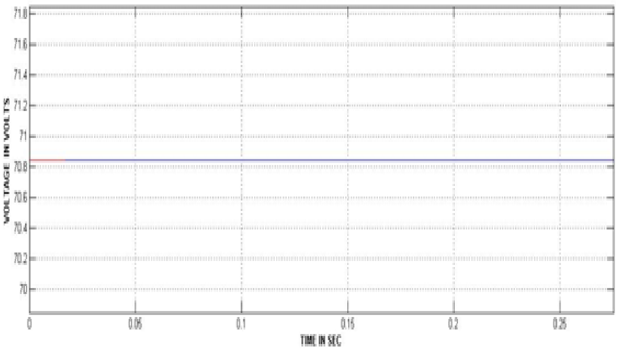
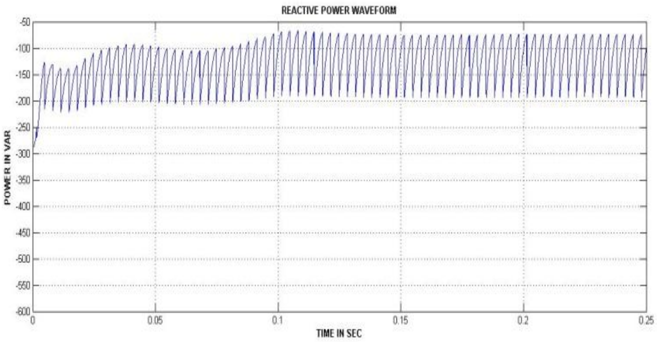


Fig 4.4 Landsman converter input voltage waveform

iii) Real And Reactive Power Waveform



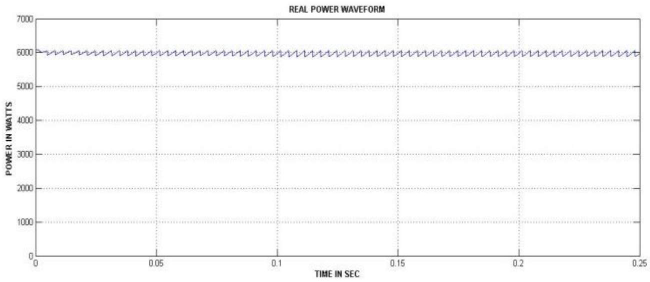


Figure 5.5 Power waveforms

iv) Dfig Output Waveform

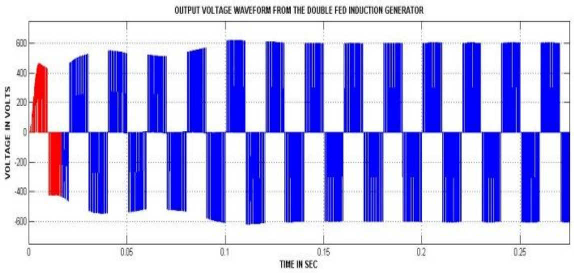


Figure 4.6: DFIG output AC voltage waveform

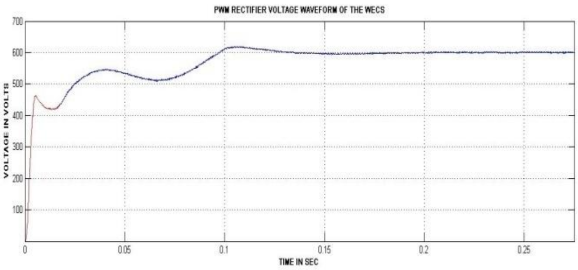
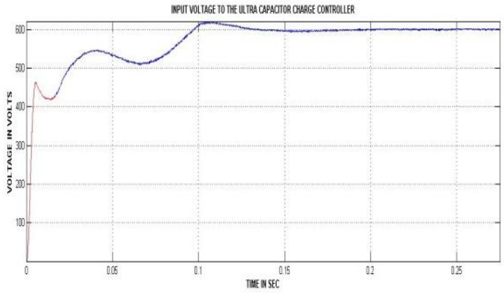


Figure 4.7 : DFIG system output DC voltage waveform

v)Ultra capacitor input & output waveform



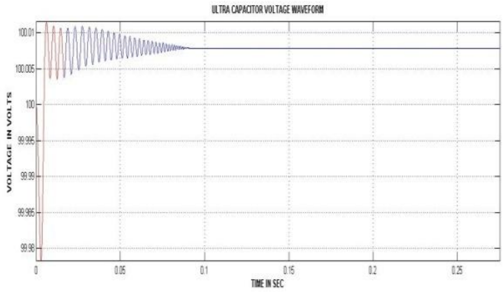


Figure 4.8: Capacitor input and output DC voltage waveform

i)Battery Voltage Waveform

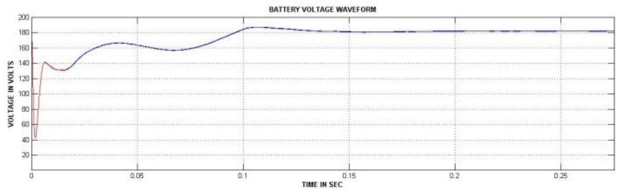
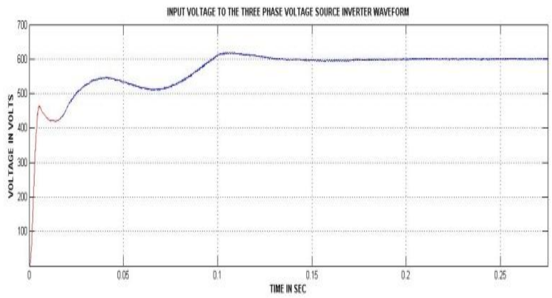
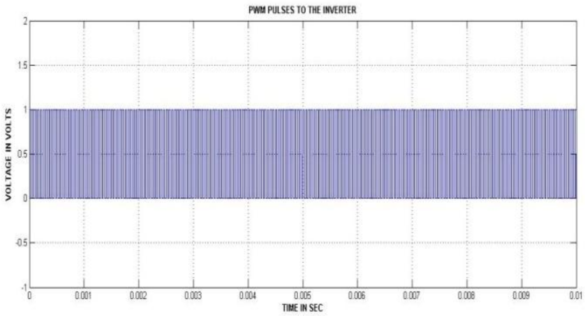


Figure 4.9: Battery output DC voltage waveform

Vii) Three Phase Voltage Source Inverter Input And Output Waveform





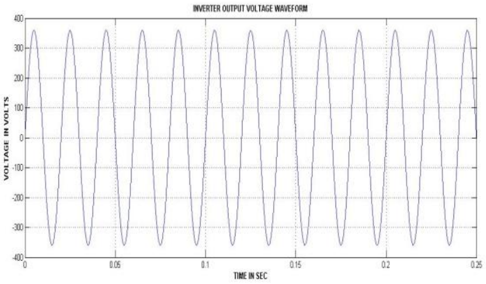


Figure 4.10: Inverter section waveforms

VI. CONCLUSION

The modelling of hybrid microgrid for power system configuration is done in MATLAB/SIMULINK environment. The present work mainly includes the grid tied mode of operation of hybrid grid. The models are developed for all the converters to maintain stable system under various loads and resource conditions and also the control mechanism are studied. MPPT fuzzy algorithm is used to harness maximum power from DC sources and to coordinate the power exchange between DC and AC grid. Although the hybrid grid can diminish the processes of DC/AC and AC/DC conversions in an individual AC or DC grid, there are many practical problems for the implementation of the hybrid grid based on the current AC dominated infrastructure. The efficiency of the total system depends on the diminution of conversion losses and the increase for an extra DC link. The hybrid grid can provide a reliable, high quality and more efficient power to consumer. The hybrid grid may be feasible for small isolated industrial plants with both PV systems and wind turbine generator as the major power supply.

VII.REFERENCES

[1]. Shailendra Kr. Tiwari ,Bhim Singh, "Design and Control of Micro-Grid fed by Renewable Energy Generating Sources" in *IEEE* , pp. 1-6, 2017.

[2]. Michael Angelo Pedrasa and Ted Spooner, "A Survey of Techniques Used to Control Microgrid Generation and Storage during Island Operation," in *AUPEC*, 2006.

[3]. F. D. Kanellos, A. I. Tsouchnikas, and N. D. Hatziargyriou, "Microgrid Simulation during Grid-Connected and Islanded Mode of Operation," in *Int. Conf. Power Systems Transients (IPST'05),* June. 2005.

[4]. Y. W. Li, D. M. Vilathgamuwa, and P. C. Loh, " Design, analysis, and real-time testing of a controller for multi bus microgrid system", *IEEE Trans. Power Electron.*, vol. 19, pp. 1195-1204, Sep. 2004.

[5]. R. H. Lasseter and P. Paigi, "Microgrid: A conceptual solution," in *Proc. IEEEPESC' 04*, pp. 4285-4290, 2004.

[6]. F. Katiraei and M. R. Iravani, "Power Management Strategies for a Microgrid with Multiple Distributed Generation Units," *IEEE trans. Power System*, vol. 21, no. 4, Nov. 2006.

[7]. P. Piagi and R. H. Lasseter, "Autonomous control of microgrids," in *Proc. IEEE-PES'06*, 2006, *IEEE*, 2006.

[8]. M. Barnes, J. Kondoh, H. Asano, and J. Oyarzabal, "Real-World MicroGrids- an Overview," in *IEEE Int. Conf. Systems of Systems Engineering*, pp.1-8, 2007.

[9]. Chi Jin, Poh Chiang Loh, Peng Wang, Yang Mi, and Frede Blaabjerg, "Autonomous Operation of Hybrid AC-DC Microgrids," in *IEEE Int. Conf. Sustainable Energy Technologies*, pp. 1-7, 2010.

[10]. Y. Zoka, H. Sasaki, N.Yomo, K. Kawahara, C. C. Liu, "An Interaction Problem of Distributed Generators Installed in a MicroGrid," in *Proc. IEEE Elect. Utility Deregulation, Restructuring and Power Technologies*, pp. 795-799, Apr. 2004.

[11]. H. Nikkhajoei, R. H. Lasseter, "Microgrid Protection," in *IEEE Power Engineering Society General Meeting*, pp. 1-6, 2007.

[12]. Zhenhua Jiang, and Xunwei Yu, "Hybrid DC- and AC-Linked Microgrids: Towards Integration of Distributed Energy Resources," in *IEEE Energy2030 Conf., pp.1*-8, 2008.

[13]. Bo Dong, Yongdong Li, ZhixueZheng, Lie Xu "Control Strategies of Microgrid with Hybrid DC and AC Buses," in *Power Electronics and Applications, EPE'11, 14thEuropean Conf.*, pp. 1-8, 2011.

[14]. Dong Bo, Yongdong Li , and Zedong Zheng, "Energy Management of Hybrid DC and AC Bus Linked Microgrid," in *IEEE Int. Symposium Power Electronics for Distributed Generation System*, pp. 713-716, 2010.

[15]. Xiong Liu, Peng Wang, and Poh Chiang Loh, "A Hybrid AC/DC Microgrid and Its Coordination Control," *IEEE Trans. Smart Grid*, vol. 2, no. 2, pp. 278-286 June. 2011.

[16]. Mesut E. Baran, and Nikhil R. Mahajan, "DC Distribution for Industrial Systems: Opportunities and Challenges," *IEEE Trans. Industry Applications*, vol. 39, no. 6, pp. 1596-1601, Nov/Dec. 2003.