HIGH GAIN LUO CONVERTER BASED GRID CONNECTED HYBRID ENERGY SYSTEM

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Abstract:**This project 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. 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 Luo converter in a cost-effective way. The voltage and frequency are controlled through an indirect vector control of the line side converter, which is incorporated with droop characteristics. 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 system is also able to work when wind power source is unavailable. Both wind and solar energy blocks, have maximum power point tracking (MPPT) in their control algorithm. The system isdesigned for complete automatic operation taking consideration of all the practical conditions. The system is also provided with a provision of external power support for the battery charging without any additional requirement. Neuro Fuzzy logic algorithm is used to track the power from PV system. A simulation model of system is developed in MATLAB environment and simulation results are presented for various conditions e.g. unviability of wind or solar energies, unbalanced and nonlinear loads, low state of charge of the battery and the hardware is developed using DSPIC30F4011 controller.**

KEYWORDS: LUO converter, DFIG, MPPT, MATLAB, DSPPIC30F4011.

I INTRODUCTION

As electric distribution technology steps into the next century, many trends are becoming noticeable that will change the requirements of energy delivery. These modifications are being driven from both the demand side where higher energy availability and efficiency are desired and from the supply side where the integration of distributed generation and peaks having technologies must be accommodated. Power systems currently undergo considerable change in operating requirements mainly as a result of deregulation and due to an increasing amount of distributed energy resources (DER). In many cases DERs include different technologies that allow generation in small scale (micro sources) and some of them take advantage of renewable energy resources (RES) such as solar, wind or hydro energy. Having micro sources close to the load has the advantage of reducing transmission losses as well as preventing network congestions. Moreover, the possibility of having a power supply interruption of end-customers connected to a low voltage (LV) distribution grid (in Europe 230 V and in the USA 110 V) is diminished since adjacent micro sources, controllable loads and energy storage systems can operate in the islanded mode in case of severe system disturbances. This is identified nowadays as a microgrid. Figure1.1 depicts a typical microgrid. The distinctive microgrid has the similar size as a low voltage distribution feeder and will rare exceed a capacity of 1 MVA and a geographic span of 1 km. Generally, more than 90% of low voltage domestic customers are supplied by underground cable when the rest is supplied by overhead lines. The microgrid often supplies both electricity and heat to the customers by means of combined heat and power plants (CHP), gas turbines, fuel cells, photovoltaic (PV) systems, wind turbines, etc. The energy storage systems usually include batteries and flywheels. The storing device in the microgrid is equivalent to the rotating reserve of large generators in the conventional grid which ensures the balance between energy generation and consumption especially during rapid changes in load or generation. From the customer point of view, microgrids deliver both thermal and electricity requirements and in addition improve local reliability, reduce emissions, improve power excellence by supportive voltage and reducing voltage dips and potentially lower costs of energy supply.

II EXISTING SYSTEM

This paper proposes a hybrid ac/dc micro grid to reduce the processes of multiple dc–ac–dc or ac–dc–ac conversions in an individual ac or dc grid. The hybrid grid consists of both ac and dc networks connected together by multi-bidirectional converters. AC sources and loads are connected to the ac network whereas dc sources and loads are tied to the dc network. Energy storage systems can be connected to dc or ac links. The proposed hybrid grid can operate in a grid-tied or autonomous mode. The coordination control algorithms are proposed for smooth power transfer between ac and dc links and for stable system operation under various generation and load conditions. Uncertainty and intermittent characteristics of wind speed, solar irradiation level, ambient temperature, and load are also considered in system control and operation. A small hybrid grid has been modelled and simulated usingthe Simulink in the MATLAB. The simulation results show that the system can maintain stable operation under the proposed coordination control schemes when the grid is switched from one operating condition to

another.

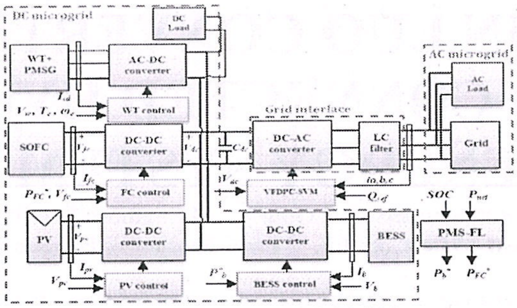

Fig 1 CIRCUIT DIAGRAM

III PROPOSED METHOD

The concept of microgrid is considered as a collection of loads and micro sources which functions as a single controllable system that provides both power and heat to its local area. This idea offers a new paradigm for the definition of the distributed generation operation. To the utility the microgrid can be thought of as a controlled cell of the power system. For example this cell could be measured as a single dispatch able load, which can reply in seconds to meet the requirements of the transmission system. To the customer the microgrid can be planned to meet their special requirements; such as, enhancement of local reliability, reduction of feeder losses, local voltages support, increased efficiency through use waste heat, voltage sag correction. The main purpose of this concept is to accelerate the recognition of the advantage offered by small scale distributed generators like ability to supply waste heat during the time of need. The microgrid or distribution network subsystem will create less trouble to the utility network than the conventional micro generation if there is proper and intelligent coordination of micro generation and loads. Microgrid considered as a 'grid friendly entity" and does not give undesirable influences to the connecting distribution network i.e. operation policy of distribution grid does not have to be modified.

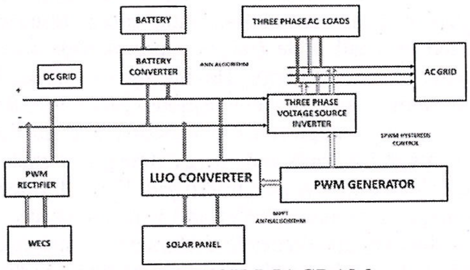

Fig 2. BLOCK DIAGRAM

The configuration of the hybrid system is shown in Figure 4.1 where various AC and DC sources and loads are connected to the corresponding AC and DC networks. The AC and DC links are linked together through two transformers and two four quadrant operating three phase converters. The AC bus of the hybrid grid is tied to the utility grid. Figure 4.2 describes the hybrid system configuration which consists of AC and DC grid. The AC and DC grids have their corresponding sources, loads and energy storage elements, and are interconnected by a three phase converter. The AC bus is connected to the utility grid through a transformer and circuit breaker. In the proposed system, PV arrays are connected to the DC bus through boost converter to simulate DC sources. A PMSG wind generation system is connected to AC bus to simulate AC sources.

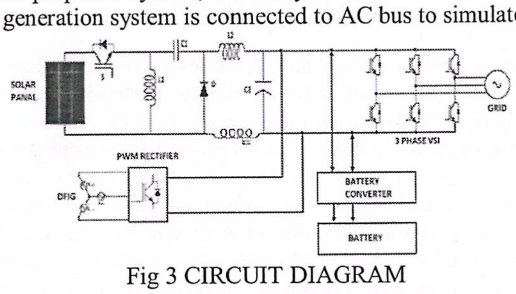

Fig 3 CIRCUIT DIAGRAM

IV SIMULATION RESULTS

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.

4.1 MATLAB SIMULINK

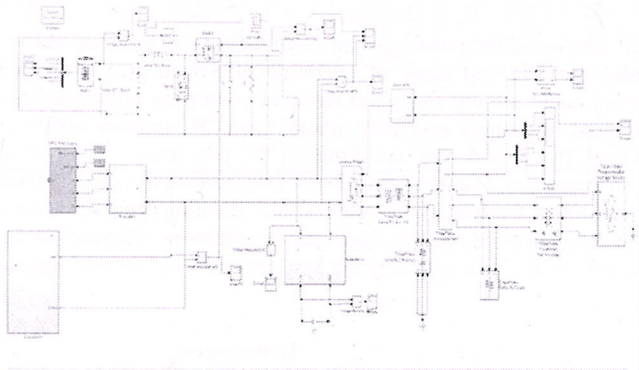

Fig 4 Proposed system simulation diagram

4.2 SOLAR PANEL OUTPUT WAVE FORM

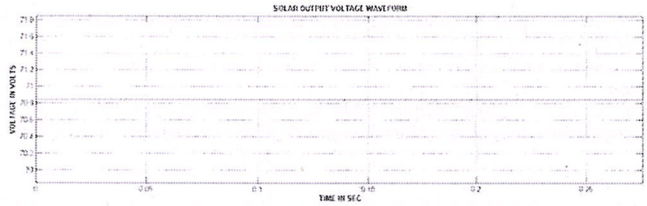

Fig 5 Solar panel output voltage waveform

4.3 LUO CONVERTER OUTPUT WAVEFORM

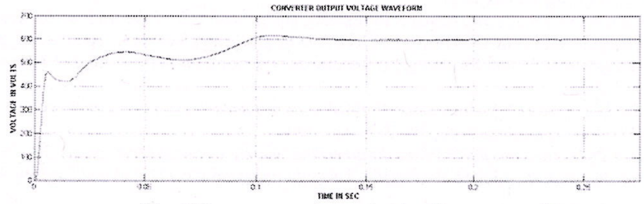

Fig 6 Luo converter output voltage waveform

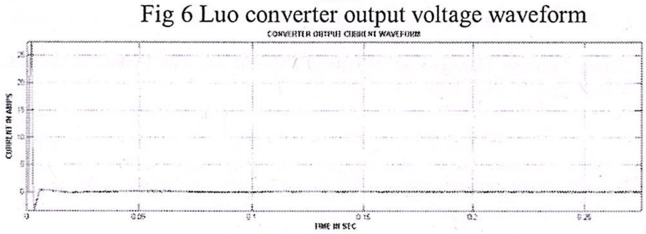

Fig 7 Luo converter output current waveform

4.4 WIND ENERGY OUTPUT WAVEFORM

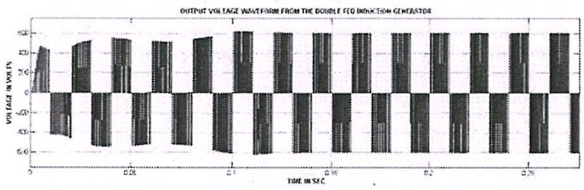

Fig 8 Wind system output AC voltage waveform

TABLE 1 COMPARISON BETWEEN EXISTING AND PROPOSED WORK

Si No	Parameters	Existing Luo converter	Modified Luo Converter
1	THD	1.98	1.18
2	MPPT Efficiency	92%	96%

V 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 Neuro 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.

References

[1] S. Bose, Y. Liu, K. Bahei-Eldin, J.de Bedout, and M. Adamiak, "Tie line Controls in Microgrid Applications," in *iREP Symposium Bulk Power System Dynamics and Control VII, Revitalizing Operational Reliability,* pp. 1-9, Aug. 2007.

[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] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, .Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011

[10] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[11] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical and Electronic Engineering, Vol.8 (3), pp.259-267, September 2012

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

[13] 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.

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

[15] 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.

[16] 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.

[17] Dong Bo, YongdongLi , 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.