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VOLTAGE CONTROL AND STABILITY ANALYSIS FOR AN AUTONOMOUS AC MICROGRID

[1]Ms.B.Limba, [2]Mr.M.C.Annamalai

[1]*M.E(II Year),Power System Engineering,Priyadarshini Engineering college,Vaniyambadi.*
[2]*M.E.,Assistant Professor,EEE.,Priyadarshini Engineering college,Vaniyambadi.*

Abstract—*Due to the fast growth in renewable energy sources, the concept of microgrid and distributed generation arises in the present grid scenario.The impact of development of these technologies has been analyzed in this paper. This study analyses the performance of microgrid with multiple distributed generation when it is connected to Linear/Nonlinear load.During the changeover of the load,the stability of the system is also monitored along with frequency. In order to do this, modeling of distributed generation with R, RL and Induction motor is carried out in this paper. The simulation was done in MATLAB/Simulink Sim power system software.*

Keywords-*Distributed Generation; microgrid; MATLAB/Simulink..*

1. INTRODUCTION

A Micro-grid can be defined as an electrical network of small modular distributed generating units (Micro sources), energy storage devices, controllable loads and protective unit to supply the local area with heat, cold and electric power. A micro-grid is a portion of power system which includes multiple DG units. It is capable of operating either in parallel with or independent from a large utility grid that provides continuous power to multiple loads and end-users [1]. It can able to generate the maximum limit of power upto 1MW. The microgrid provides many advantages like better reliability,reduction in transmission loss, small in size , reduction of CO_2 emission, improve the quality of human life and flexiblity. As it is interfaced with the main grid, the overall system performance is enhanced. The microgrid functions under three modes of operation, viz.

1. Grid connected mode
2 .Island mode
3. Transition mode

Once the microgrid is make contact with the power grid at the intersection of PCC (point of common coupling), then the microgrid operates in grid-tied mode. Once the microgrid is standing apart from the power grid, then it operates in island mode. If there exists any break down in microgrid, it will switch over to island mode automatically. This exhibits that there is no possibility of power supply interruption to the end users[9].

A distributed generation is a collection of Renewable Energy Resources such as solar, wind, hydro and fuel cell. It provides green energy and flexible extension to the utility grid. Depending upon the environmental condition it is categorized into two types, they are dispatchable and non-dispatchable. Dispatchable DGs are independent on the environmental condition. Fuel cell, biomass, bio- fuel are included in dispatchable DGs. Non dispatchable DGs are dependent on the environmental conditions [14]. The vital role of DGs includes generating power on-site rather than centrally.

In micro grid parallel DGs are controlled to deliver the desired active and reactive power to the system, while local signal are used as feedback to control the converters [8]. Hence, the power sharing among the DGs can be achieved by controlling two independent quantities - frequency and fundamental voltage magnitude.

The problem of power quality in micro-grid becomes alarming, which is the foremost area of study and it also helps in examining the impact of power quality problems [1]. When sensitive loads are linked to the micro-grid, voltage unbalances are not normally accepted and the micro-grid should be detached. Conversely, when the unbalance in voltage is not so solemn or the local load is not very critical to it, the micro-grid can endure linked to the grid.

This paper projects on the performance analysis of microgrid with various loads such as R load, R-L load and Induction motor (IM) load. The simulation results are carried out in two cases viz with LC filter and without LC filter. The parameters such as voltage, current, real and reactive power are observed with these various loads [2]. The motive to give attention on the power sharing is, for the reliable performance of the microgrid to enhance the voltage and to reduce its associated losses.

The organization of this paper is as follows. In section-2 microgrid structure is discussed. Section-3 presents DG modelling with filters. Section-4 describes the DG modelling without filters.

2. STRUCTURE OF MICRO-GRID

Microgrid is an autonomous small scale power supply network that is designed to provide a power for a small community [16]. It contains various microsources, controllable loads and storage devices. Two basic classes of micro sources are DC source (fuel cell, PV cells and battery storage) and AC sources (micro turbine). The DC voltage is converted to an acceptable AC voltage using Voltage source inverter. The main significant components of microgrid are static transfer switch (STS) and micro sources. During disturbances such as IEEE 1547 events or power quality events, the microgrid is disconnected from the main grid with the help of the static switch. Subsequently after islanding, the resynchronization of the microgrid is attained immediately after the tripping event is no longer present [10]. This synchronization is achieved by using the frequency difference between the islanded microgrid and the utility grid assuring a transient free operation without having to match frequency and phase angles at the connection point [4]. The structure of the microgrid is shown in the fig1.

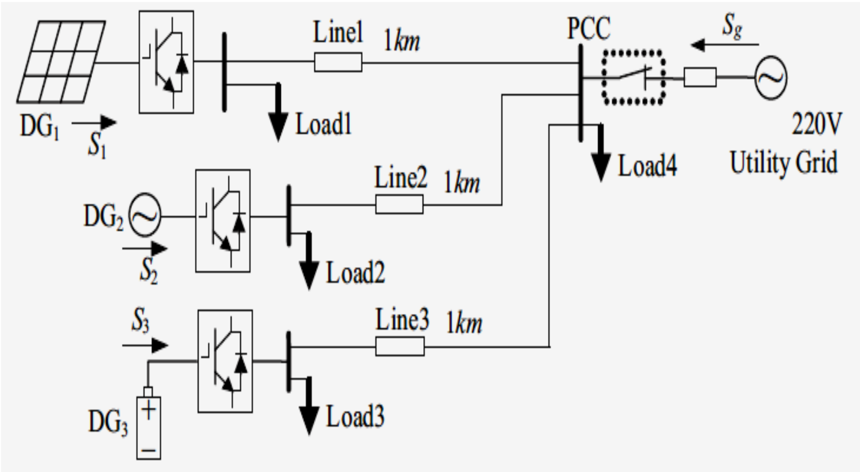

Fig.2.1. Schematic diagram of micro-grid structure

3. DISTRIBUTED GENERATION (DG)

Distributed generations are small electric power generators. Because of its size and clean energy technology, DGs can be installed close to the customers [13]. Installation & operation of electric power generation units connected to the local network or off-grid generation is characterized by:

- Generation capacity ranging from kW to MW level.
- Generation at Distribution Voltages (11kV or below).
- Grid inter-connection at distribution line side
- Inter-connected to a local grid, or
- Totally off-grid, including captive

Distributed generation generates electricity from many small energy sources [5].

- Distributed generation occurs when power is generated (converted) locally and sometimes might be shared with or sold to neighbors through the electrical grid (or over the fence)
  i. Large central generation is not directly used
  ii. The Public Service Commission may define only one supplier as a utility!

- Distributed generation avoids the losses that occur in transmission over long distances; energy is used nearby.

- Varying wind and sunshine averages across several houses, blocks, cities, or states, stabilizing the system.
  i. Variability of one source is reduced by dividing the square root of the number of sources.

- Supply is robust, but automatic precautions are required to protect electricity workers when main base-load power is out, and a local system might feed back into power lines

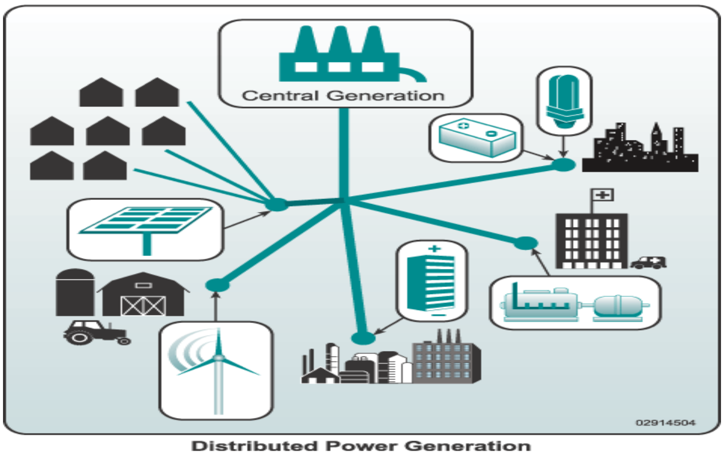

Fig.3.2. Distributed Generation

Distribution generation can be classified generally as renewable and nonrenewable DGs [15]. Micro turbines and fuel cells are considered as dispatchable DGs due to their capability of producing active power on demand whereas the solar and wind are considered as non-dispatchable DGs due to their operation according to their maximum power-tracking concept. This type of DG's output powers are dependent mainly on the weather rather than load. Hence non-dispatchable loads are considered to be negative loads. In this paper dispatchable DG is adopted i.e. DC source.

4. MODELLING AND SIMULATION RESULTS

To carry out the simulation, two distributed generator units are interconnected with different loads like linear load, R load, RL load and Induction Motor load. The investigation of the performance analysis of modeling the DG's is worked for a DG interconnected to various loads with LC filter. The DG parameters like voltage, current, real and reactive power are observed under each case.

4.1. Behaviour of DG with various loads

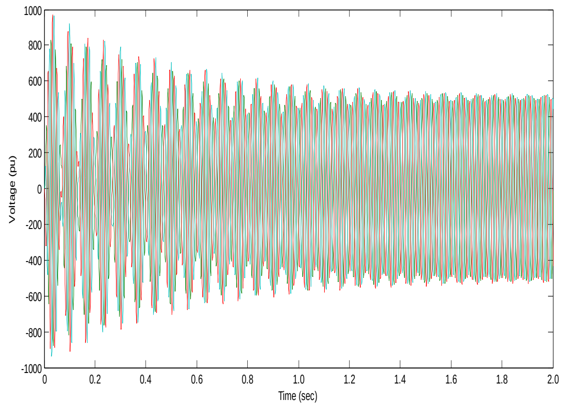

Figure 4.1(a) Voltage waveform of DG with R load

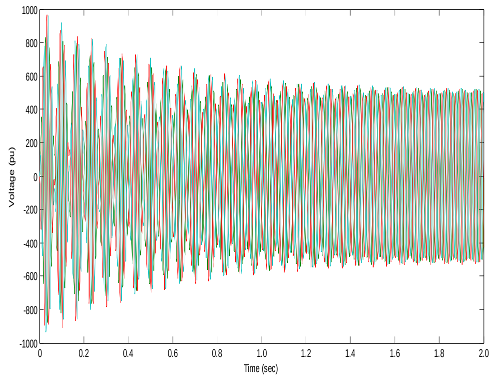

figure 4.1(b) Voltage waveform of DG with RL load

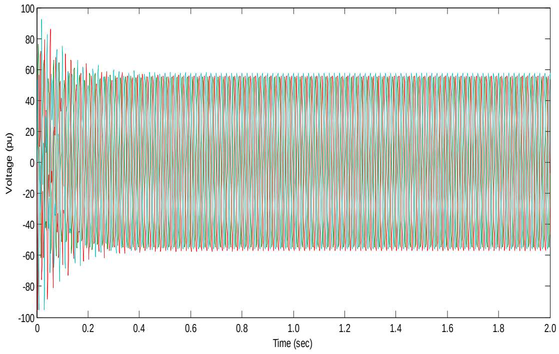

Figure 4.1 (c) voltage waveform of IM load

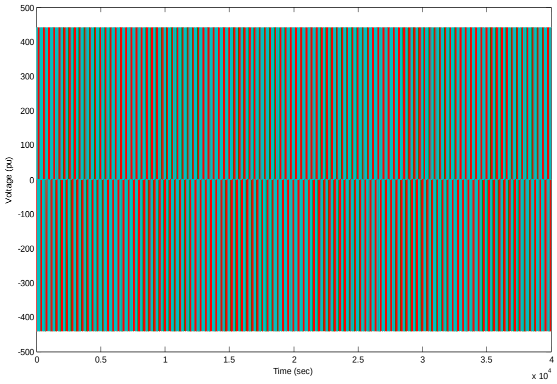

Figure 4.1 (d) voltage waveform of R,RL&IM load

Fig 4.1. (a)-(d) shows the response of voltage supplied to load. The results exhibits that the response of voltage generated by DG to induction motor load differs with type of load. Because, R and RL absorbs real power. Where, IM load injects real power due to its non-linear character.

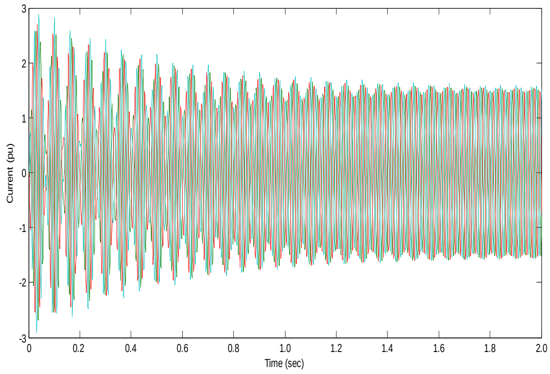

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Figure 4.1 (e) Current waveform of DG with R load

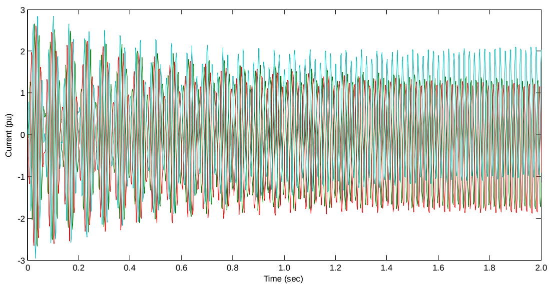


Figure4.1(f)CurrentwaveformofRLload

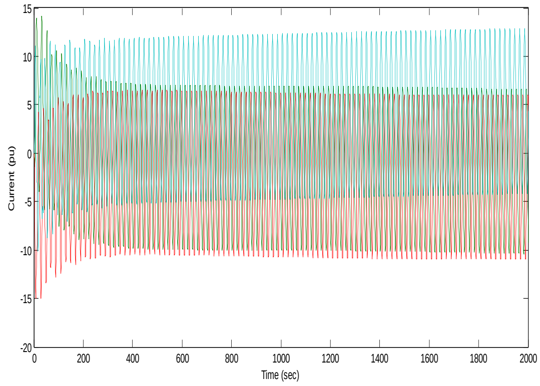


Figure4.1(g)Current waveform of IM load

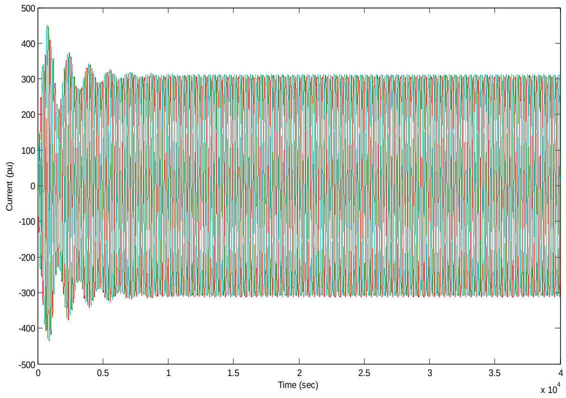


Figure4.1(h)Current waveform of R, RL& IM load

Fig 4.1. (e)-(h) shows the response of current supplied to load. The results exhibits that the response of current generated by DG to induction motor load differs with type of load. Because, R and RL absorbs real power. Where, IM load injects real power due to its non-linear character.

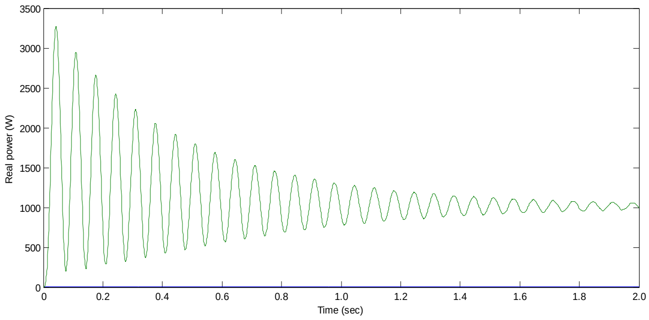


Figure 4.1 (i) Real power waveform of DG with R

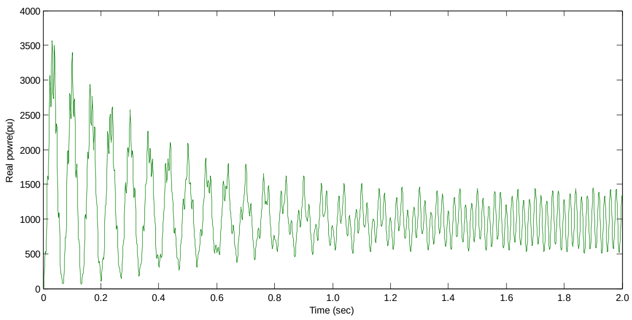


Figure 4.1(j) Real power waveform of DG with RL load

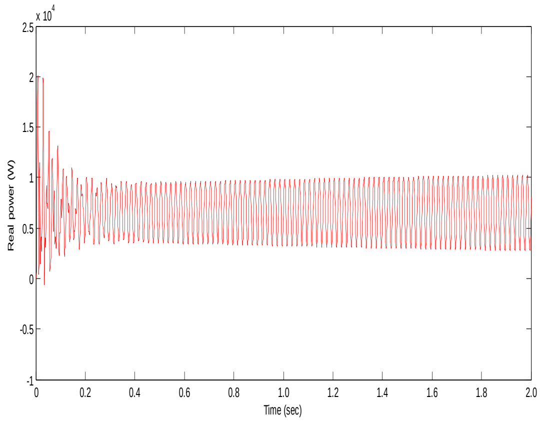


Figure 4.1(k). Real power waveform of DG with IM load

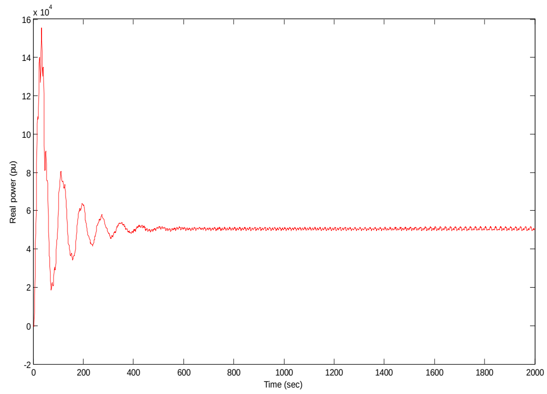


Figure 4.1(l). Real power waveform of DG with R, RL&IM load

The results of DG supplying Real power to linear load and non-linear load are shown in fig4.1. (i) – (l). Comparing the dynamic behavior of DG with R, RL and IM load, the results show that the DG gives a slightly faster response for IM load and also supplies high power. However, it is observed that the real power waveform has oscillations during start up.

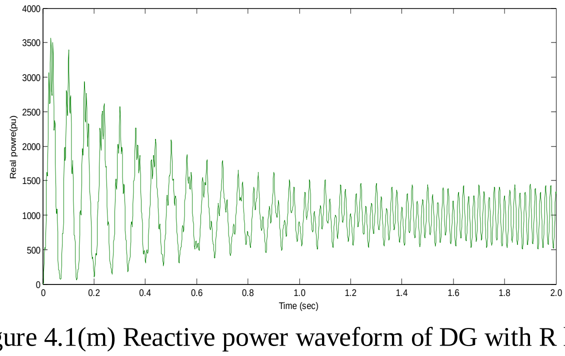


Figure 4.1(m) Reactive power waveform of DG with R load

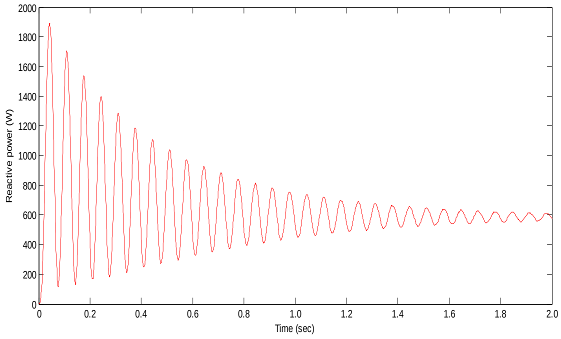


Figure 4.1(n) Reactive power waveform of DG with RL load

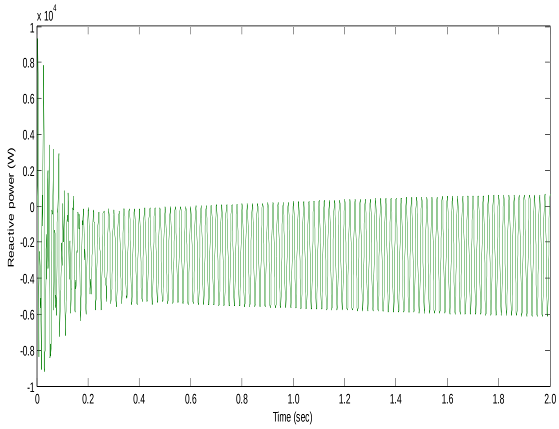


Figure 4.1(o) Reactive power waveform of DG with IM load

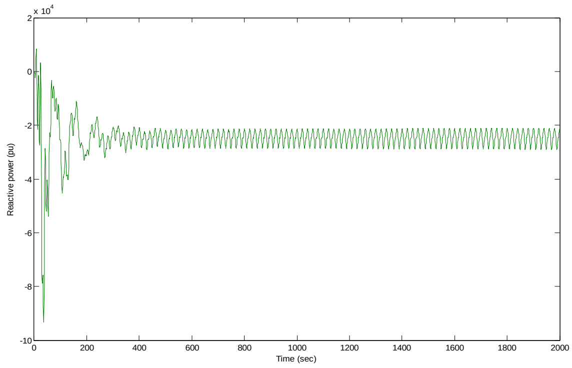
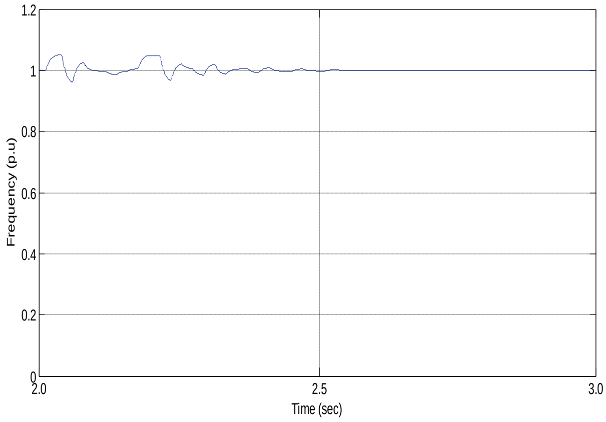


Figure 4.1(o) Reactive power waveform of DG with R, RL& IM load

Fig 4.1. (m)-(o) shows the response of reactive power supplied to load. The results exhibits that the response of reactive power generated by DG to induction motor load differs with type of load. Because, R and RL absorbs real power. Where, IM load injects real power due to its non-linear character.

Frequency variation with Non-Linear Load



5. CONCLUSION

In this paper , the performance of a microgrid with DGs are analysed.The various parameters that are monitored are Real power,Reactive power,Voltage ,Current and frequency.The stabiloity of the system was monitored while supplying Non-Linear Load. The main focus of this study is investigating the impact of various loads which it is interconnected with DG. The final report from the performance analyses shows that the impact of DG varies depending upon the types of load. The results also show that the developed modeling of DG can quickly regulate its output.

REFERENCES

1. Corzine, Keith. "Dc microgrid protection with the z-source breaker."In *Industrial Electronics Society, IECON 2013-39th Annual Conference of the IEEE*, pp. 2197-2204.IEEE, 2013.

2. Lopes, JA Peças, C. L. Moreira, and A. G. Madureira, "Defining control strategies for micro-grids islanded operation," *IEEE Transl . vol.*21, pp.916-924, 2006

3. Payasi, Rajendra Prasad, Asheesh K. Singh, and Devender Singh. "Planning of different types of distributed generation with seasonal mixed load models."*International Journal of Engineering, Science and Technology* 4, no. 1 (2012): 112-124.

4. Sao, Charles K., and Peter W. Lehn. "Intentional islanded operation of converter fed microgrids." In *Power Engineering Society General Meeting, 2006.IEEE*, pp. 6-pp. IEEE, 2006.

5. Kamel, Rashad M., AymenChaouachi, and Ken Nagasaka."Detailed analysis of micro-grid stability during islanding mode under different load conditions."*Engineering* 3, no. 5 (2011): 508.

6. Nikkhajoei, Hassan, and Robert H. Lasseter,"Distributed generation interface to the CERTS microgrid," *Power Delivery, IEEE Translvol.24, pp.1598, 2009.*

7. Hassan, M. A., and M. A. Abido. "Real time implementation and optimal design of autonomous microgrids." *Electric Power Systems Research* 109 (2014): 118-127.

8. Akhmatov, Vladislav, and Peter BørreEriksen. "A large wind power system in almost island operation—A Danish case study." *Power Systems, IEEE Translvol 22, pp. 937-943*, 2007.

9. Kasem Alaboudy, A. H., Zeineldin, H. H., & Kirtley, J. L. (2012). Microgrid stability characterization subsequent to fault-triggered islanding incidents. *Power Delivery, IEEE Transactions on*, *27*(2), 658-669.

10. Al-Nasseri, H., Redfern, M. A., & O'Gorman, R. (2005, November). Protecting micro-grid systems containing solid-state converter generation. In *Future Power Systems, 2005 International Conference on* (pp. 5-pp). IEEE.

11. Crolla, P., Roscoe, A. J., Dysko, A., & Burt, G. M. (2011, May). Methodology for testing loss of mains detection algorithms for microgrids and distributed generation using real-time power hardware-in-the-loop based technique. In *Power Electronics and ECCE Asia (ICPE & ECCE), 2011 IEEE 8th International Conference on* (pp. 833-838). IEEE.

12. Majumder, Ritwik. "Modeling, stability analysis and control of microgrid." (2010).

13. Katiraei, F., & Iravani, M. R. (2006). Power management strategiesforamicrogrid with multiple distributed generation units. *Power Systems,Transactions on*, *21*(4), 1821-1831.

14. Barklund, E., Pogaku, N., Prodanovic, M., Hernandez-Aramburo, C., & Green, T. C. (2007, April). Energy management system with stability constraints for stand-alone autonomous microgrid. In *System of Systems Engineering, 2007. SoSE'07. IEEE International Conference on* (pp. 1-6). IEEE.

15. Guerrero, J. M., Vasquez, J. C., Matas, J., Castilla, M., & de Vicuña, L. G. (2009). Control strategy for flexible microgrid based on parallel line-interactive UPS systems. *Industrial Electronics,IEEE Transactions on*, *56*(3), 726-736.

16. Hornik, T., & Zhong, Q. C. (2011). A Current-Control Strategy for Voltage-Source Inverters in Microgrids Based on and Repetitive Control. *Power Electronics, IEEE Transactions on*, *26*(3), 943-952.

