ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Optimization of Distributed Generation System

R. Divya[1*] and **K.Thenmalar[2]**
[1]Power Systems Engineering, Vivekananda College of Engineering for Women (Autonomous) Elayampalayam, Tiruchengode, Namakkal
[2]Department of Electrical and Electronics, Vivekananda College of Engineering For Women (Autonomous), Elayampalayam, Tiruchengode, Namakkal
***Corresponding author: E-mail: divyabharatheee@gmail.com**

ABSTRACT

The proportional-integral (PI) and neuro controllers of a voltage source cascaded converter with two additional loops for smooth change of islanding and resynchronization operation in a distributed-generation (DG) system is presented in this paper. The first loop is the frequency control loop which is enfolded on the real power set point of the cascaded controller of the voltage source converter to reduce the frequency variation during the change from the grid mode to standalone mode. The second loop is the resynchronization loop which minimizes the phase shift of the AC voltage of the DG unit with the utility grid AC voltage during islanding operation leading to successful grid reconnection event. When the DG unit is connected to grid, produce harmonics problem which can be controlled using PID and neuro controller. THD level for both controller are compared. The comparisons result proves that THD level for neuro controller is smaller than PID controller which is simulated using MATLAB software.

KEY WORDS: Distributed generation (DG), gridsideconverter, pro-portional-integral (PI)

1. INTRODUCTION

Due to the exhaust condition of industrial fuels which include oil, gas etc., the development of renewable energy sources is encouraged. This is the reason why renewable energy sources have become more important these days. Other advantages like huge availability in nature eco-friendly recyclable. Many renewable energy sources are solar, wind, hydel and tidal. Among these renewable energy source solar and wind energy system world's fastest germinating energy resources. With no emission of pollutant energy conversion is done through wind and PV cell.
Day by day, the demand for electricity is increasing. But the available base load plants cannot supply electricity as per demand. So these renewable energy sources can be used to supply demand during peak loads. This kind of stand-alone power generating systems can also be used in rural areas where conventional power generation is impractical. The wind-photovoltaic hybrid power generation system model is studied. A hybrid system is better as individual power generation system is not completely impeccable. When any one of the system is closed the other can supply power. The block diagram of entire hybrid system is shown below.

Recently, the availability of power in India has not just increased but also improved, although the demand consistently rose more than the supply. That's why non-conventional sources have become popular. Among these fast growing non-conventional sources the wind energy system and solar photovoltaic system are very common. Now India has become fifth in installed capacity of both wind and solar power plant. As of 30th September 2013 the installed capacity of wind power in India was 19881MW. But, as the wind is season and region based, it was unreliable so hybrid system used.

The main objective of the thesis is to implement a power system that is a hybrid of both Photovoltaic and wind powers. To study and model, PV panel**.** To study the characteristics curve and effects of variation of environmental conditions like temperature and irradiation on them**.** To study and simulate the PV module's behavior**.** To trace the maximum power point of operation of the PV panel irrespective of the changes in the environmental conditions**.** To study and simulate the wind power system**.** Implement hybrid system

A method to apply a generalized systematic approach, is useable to identify the faults' effect on load points' reliability especially for intentional islanding, with sequential Monte Carlo simulation (RMCS, SMCS) in order to determine distribution system reliability in smart grids is described. A study case is presented to validate the results of the proposed method in comparison with the analytical one. Finally, the results proves that islanding positively affects reliability and then it could become a standard practice provided that the main technical issues are addressed. In radial system, the distributed generators are located using Harmony Search (HS) algorithm. The approach uses multiple objective planning framework, titled an Improved Multi objective HS (IMOHS), to determine the impact of DG placement and sizing for an optimal development of the distribution system. The optimum sizes and locations of DG units are evaluated by seeing the power losses and voltage profile as objective function. The characteristic of a PEM fuel cell is highly nonlinear, a first class optimization technique is needed. So an innovative global harmony search (IGHS) algorithm-based parameter identification method is used. The IGHS algorithm is used for parameter identification of the SR-12 Modular PEM Generator, the Ballard Mark V FC, Simulation results shows that the proposed technique deliver both better and more robust results than the other studied algorithms.

2. SYSTEM MODEL

Block Diagram: The entire hybrid system consists of PV and the wind systems. The PV system generate energy from the solar energy which is abundantly available in nature. The light incident on the PV cells is changed into electrical energy by solar energy harvesting means. MPPT techniques track the maximum power and generate maximum power from PV panel. The dc-dc converter is used to boost the voltage and varying voltage to fixed voltage. To feed DC load, it can be connected to the output of DC-DC converter. Battery Energy storage system stores the energy and delivered to grid when solar power is low. DC-AC converter is used to feed AC load so ac load is connected through DC-AC converter.

Wind turbine, gear box, generator are included in the wind energy system. The wind turbine converts wind energy to mechanical energy and this mechanical energy available at the turbine shaft is changed to electrical energy using a generator. Generated energy is given to load through coupling transformer.

Grid power is given to load through switch. When the switch is closed, loads are fed from both DG unit and grid. When the switch is open loads are connected from DG unit only. When there is a fault in distribution substation in order to provide uninterruptible power supply we need distribution generation system .Also if load demand increases DG unit will supply the demand immediately. To supply the demand other way is to increase the generation through the erection of new power plant. To erect new power plant we need many years, So DG system is the best way to supply load demand.

Hybrid generation systems that utilizes more than a single power source can greatly improve the certainty of load demands all the time. Even higher generating capacities can be obtained by hybrid system. In stand-alone system or islanding mode we can provide fluctuation free output to the load irrespective of weathers condition. Power from PV system is stored in battery energy storage system and constant power is delivered by wind turbine, an efficient energy storage mechanism is required, which can be realized by the battery.

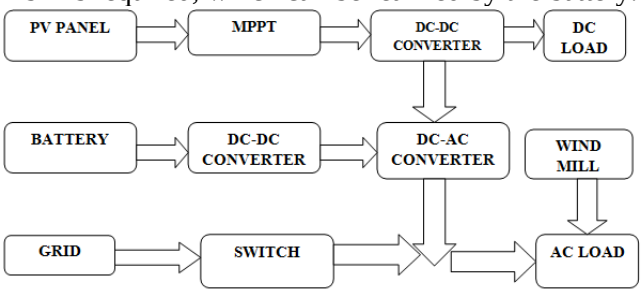

Figure.1.Output Voltage of Dc-Ac Converter

Model of PV system: Solar radiation is converted into electrical energy by PV system. Current source in parallel with diode and combination of series and parallel resistance is a modeling of practical PV system. Based on solar radiation and temperature photo current is generated. The reserve saturation current due to p-n junction of the solar cell while the resistance accounts for losses.

GSC control strategy: Variation of ac voltage magnitude and frequency occurs due to loss of balance while DG unit is disconnected from the grid, then DG system become unstable. GSC is used to control the real and reactive powers between ac and dc sides. According to the set points in the control strategy real and reactive powers are controlled. The real power is controlled using d-axis current, similarly terminal voltage is maintained using q-axis current. The input of the phase locked loop system is grid side three phase voltages, the output of PLL system is transformation angle. The real power control is obtained using additional loop of direct frequency control which minimizes the variation of the frequency during the islanding event. During the islanding event using a latch system frequency control loop is enabled.

Resynchronization technique is another important issue in the islanding events. The voltage of the DG unit is resynchronized for successful grid reconnection mode. Despite the voltage magnitude and frequency regulation the DG ac voltage is phase shifted from the utility grid voltage during the islanding event. For soft transition from the islanding mode to grid reconnection mode an additional loop is added to the real power of the cascaded control. The input of resynchronization block is the voltage signals of DG unit and utility grid.The error signal generated from PI controller is used for synchronization. During islanding mode the transformation angle for the d-q frame is unknown so voltages are taken in the resynchronization block. Before reconnecting DG unit with utility gridthe phase of ac voltage should be adjusted for synchronization.

In this control strategy for successful islanding and grid resynchronization six PI controllers are needed, however the number of PI controllers is reduced from six to four by minimizing the inner loop and outer loop of real and reactive power control. Instead therefore the parameters with eight design variables is optimally designed in this study.

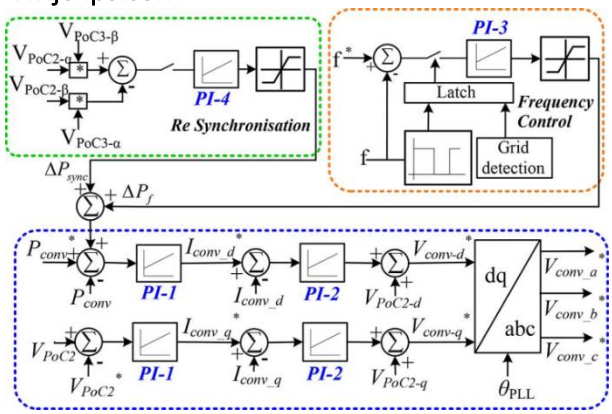

Figure.2 Output Voltage of Dc-Ac Converter

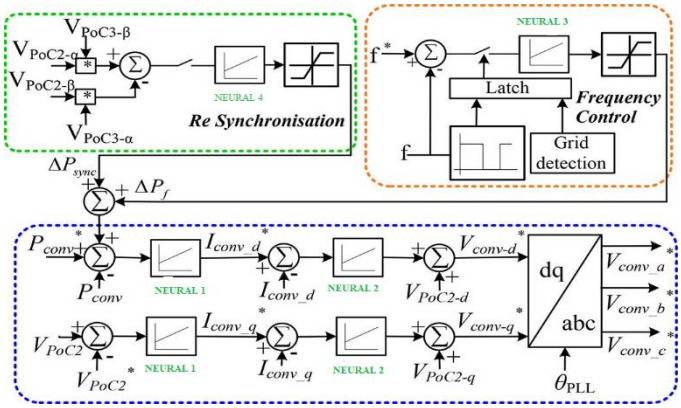

Figure.3 Output Voltage of Dc-Ac Converter

3. RESULT AND DISCUSSIONS

Using P, PI, PID Controllers the load voltage, current & THD level are same. These controllers provides overshoot and settling time high. But using controller it will reach the target faster than PID controllers so settling time less and does not provide overshoot. Using Neuro controller THD LEVEL generated is 3.23%. Similarly using PID controller THD level generated is 3.94%. Comparing PID & NEURO Controller THD level generated using neuro controller is less. It is reduced by 0.71%.

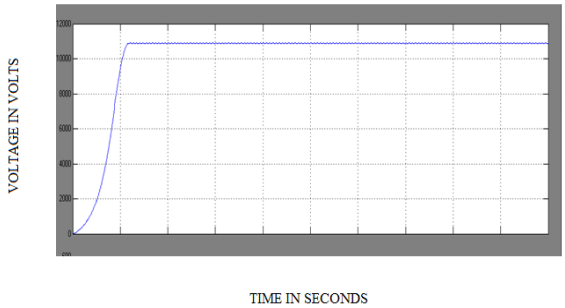

Figure.4.Output voltage of boost converter
VOLTAGE=11000 V

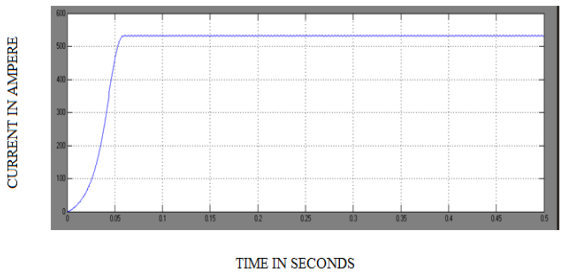

Figure.5.Output current of boost converter
CURRENT=550 A

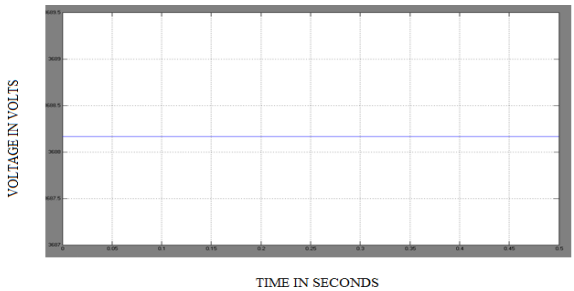

Figure.6.Output Voltage of PV Panel
VOLTAGE=3688.2 V

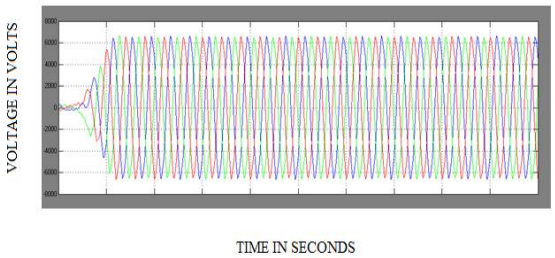

Figure.7.Output Voltage of Dc-Ac Converter
VOLTAGE=6.6KV

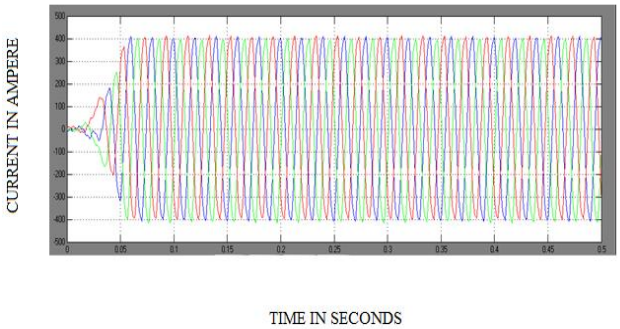

Figure.8.Output Current of Dc-Ac Converter
CURRENT= 400A

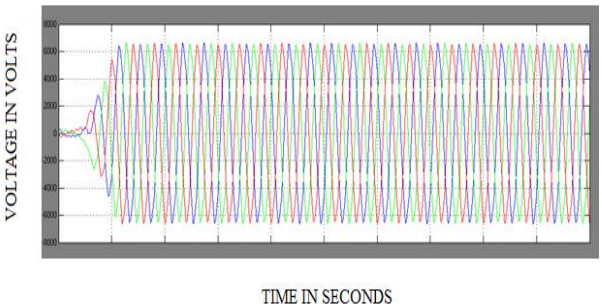

Figure.9.Output Voltage of Wind Energy System
VOLTAGE=6.6 KV

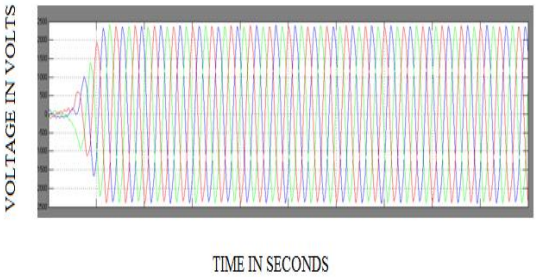

Figure.10.Load Voltage(Voltage=2.4 KV)

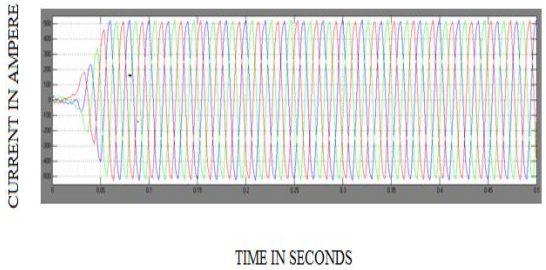

Figure.11.Load Current (Current=500 A)

Table 1. Load Voltage, Current & THD Value

Controller	Voltage in kv	Current in a	Thd in %
P	2.4	500	3.94
Pi	2.4	500	3.94
Pd	2.4	500	3.94
Pid	2.4	521	3.94
Neural network	2.4	623	3.23

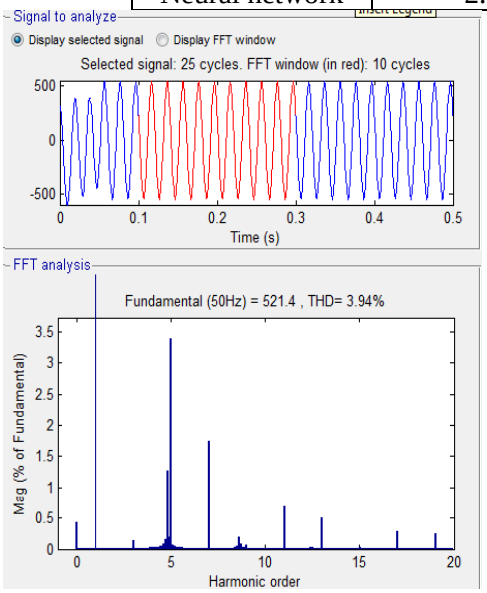

Figure.12.FFT Analysis Using PID Controller

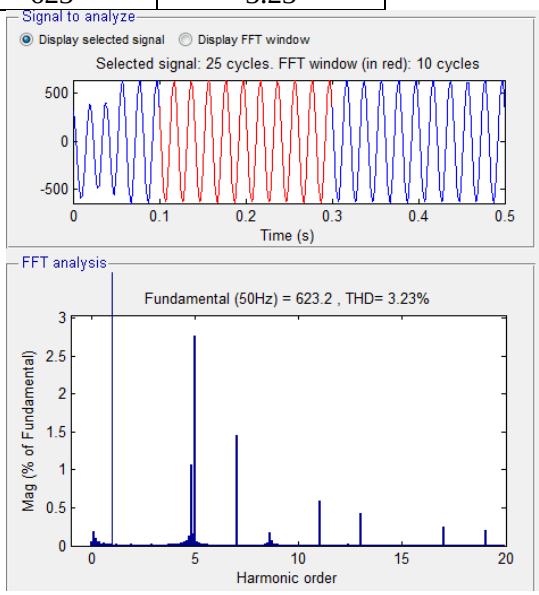

Figure.13.FFT Analysis Using Neuro Controller

4. CONCLUSION

The parameter optimization scheme is applied for islanding and grid resynchronization of a DG system where multiple PID controllers are used in cascaded control loops to control real and reactive power simultaneously along with two additional loops for smooth change of islanding and resynchronization operations. It optimally determines the parameters of multiple PID controllers in cascaded control of the power converter used in the DG system for successful islanding and grid desynchronizing operations. PV panel and Maximum power point tracking system which tracks maximum power using P&O algorithm is simulated using MATLAB. Wind energy system has been simulated using MATLAB. Both wind energy system and solar energy system are integrated forming hybrid energy system. The proposed technique is equally applicable to different renewable energy, an energy-storage system, and power system applications. Neural network is utilized alternative to PID controller. Comparing both techniques neural network is better to PID controller because THD value is smaller than PID controller. MPP can be tracked using different algorithms. Fuel cell can be included to Hybrid system to serve the load. Different types of inverter can be used to provide high efficient output to load. MPP tracking can also be applied for wind energy system.

5. ACKNOWLEDGEMENT

I acknowledge that some of the text and diagram in this paper are referred from IEE paper harmonic search algorithm based controller parameter optimization for distributed generation system.

REFERENCES

Ambia, Mir Nahidul, Hany M. Hasanien, Ahmed Al-Durra, and Muyeen SM. Harmony Search Algorithm-Based Controller Parameters Optimization for a Distributed-Generation System, IEEE Transactions on Power Delivery, 30(1), 2015.

Askarzadeh A and Rezazadeh A, An Innovative Global Harmony Search Algorithm for Parameter Identification of a PEM Fuel Cell Model, IEEE Transactions Industrial Electronics, 59(9), 2012, 3473–3480,

Geem Z.W, Kim J.H, and Loganathan G.V, Anew Heuristic Optimization Algorithm: Harmony Search, Simulation, 76(2), 2001, 60–68.

Hasanien H.M and Muyeen S.M, A Taguchi Approach for Optimum Design of Proportional-Integral Controllers in Cascaded Control Scheme, IEEE Transactions Power System, 28(2), 2013, 1636–1644.

Hasanien HM and Muyeen SM, Design Optimization of Controller Parameters Used Invariable Speed in Energy Conversion System by Genetic Algorithms, IEEE Transactions Sustainable Energy, 3(2), 2012, 200–208.

Hasanien HM, Design Optimization of PID Controller in Automatic Voltage Regulator System Using Taguchi Combined Genetic Algorithm Method, IEEE System Journal, 7(4), 2013, 825–831.

Hatziargyriou ND and Meliopoulos APS, Distributed Energy Sources: Technical Challenges, in Proceedings

IEEE Power Engineering Society Winter Meeting, New York, USA, 2. 1017-1022

Lopes L and Almeida R, Wind-Driven Self-Excited Induction Generator with Voltage and Frequency Regulated by a Reduced Rating Voltage Source Inverter, IEEE Transactions Energy Conversions, 21(2), 2006, 297–304.

Muyeen SM, Ali MH, Takahashi R, Murata T, Tomaki Y, Sakahara A, and Sasano E, Comparative Study on Transient Stability Analysis of Wind Turbine Generator System Using Different Drive Train Models, IET Renewable Power Generation, 2(2), 2007, 131–141.

Muyeen SM, Hasanien H.M, and Tamura J, Reduction of Frequency Fluctuation for Wind Farm Connected Power Systems by an Adaptive Artificial Neural Network Controlled Energy Capacitor System, IET Renewable Power Generation, 6(4), 2012, 226–235.

Nekooei K, Farsangi MM, Hossein N, and Lee KY, An Improved Multi-Objective Harmony Search for Optimal Placement of DGs in Distribution Systems, IEEE Transactions Smart Grid, 4(1), 2013, 557–567.

Rayapudi SR, Sadhu VLN, Manyala RR, Srinivasa A, Optimal Network Reconfiguration of Large-Scale Distribution System Using Harmony Search Algorithm, IEEE Transactions Power System, 26(3), 2011, 1080–1088.

Smallwood CL, Distributed Generation in Autonomous and Non-Autonomous Micro Grids, Proceedings Rural Electrical Power Conference, Colorado Springs, CO, 2002, 1-6.

Vachtsevanos G and Kalaitzakis K, A Hybrid Photo Voltaic Simulator for Utility Inter Active Studies, IEEE Transactions Energy Conversions, 2(2), 1987, 227–231.

Verma A, Panigrahi B.K and Bijwe P.R, Harmony Search Algorithm for Transmission Network Expansion Planning, IET Generation, Transmission and Distribution, 4(6), 2010, 663–673.

Wasynczuk O, Man DT, and Sullivan JP, Dynamic Behavior of a Class of Wind Turbine Generators during Random Wind Fluctuations, IEEE Transactions Power Engineering Revolution, 100(6), 1981, 47–48.

Wei L, Guo W, Wen F, Ledwich G, Liao Z, and Xin J, Waveform Matching Approach for Fault Diagnosis of a High-Voltage Transmission Line Employing Harmony Search Algorithm, IET Generation, Transmission and Distribution, 4(7), 2010, 801–809.

You H, Vittal V, and Yang Z, Self-Healing in Power Systems: An Approach Using Islanding and Rate Off Frequency Decline- Based Load Shedding, IEEE Transactions Power System, 18(1), 2004, 174–181.