www.ijiarec.com

ISSN:2348-2079

Volume-7 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

Stability analysis in smart grid for reactive power management using PV

Dr.R.Sathish, B.Tech., M.E., Ph.D., M.Namachivayam

Associate Professor, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India

PG Scholar, M.E-Power Systems Engineering, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamilnadu, India.

ABSTRACT

Power systems are complex systems consisting of large number of generating units and interconnected network of transmission lines. The voltage stability, power factor. Harmonics is an issue of prime importance in this complex power system network since the demand for electric power is increasing drastically. The control of reactive power in the transmission lines will enhance the voltage stability of the power system network. This paper presents the design and implementation of the static VAR Compensator (SVC) in the transmission network for reactive power flow control to improve the voltage stability. The proposed method detects automatically the optimal number of SVCs required for the control of reactive power. The detailed simulation study has been carried out in hardware.

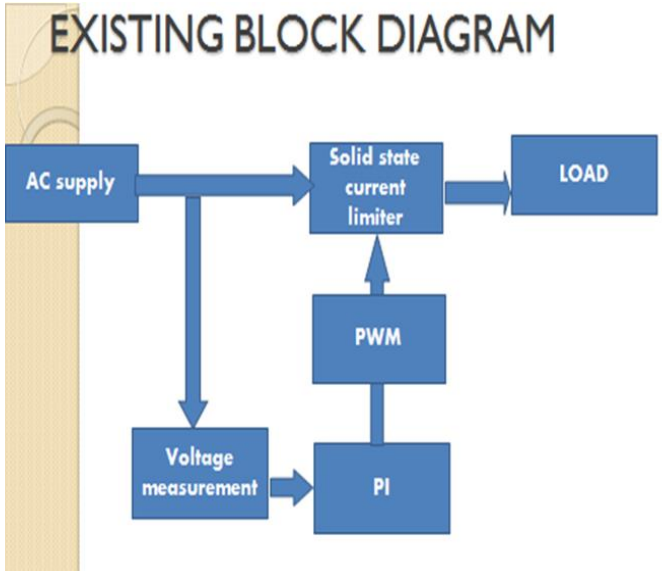
Keywords: PV-Wind-Diesel Microgrid; IG; TCSC; ANN Controller.

INTRODUCTION

Fault in distribution networks according to its specifications (its location, duration and time) can cause an interruption or a voltage sag at the nodes of the network. By making random faults, the voltage sag in such networks can be investigated. However, the utilization of super conductors in the present scenario is decreased due to its high capable of technology and economic considerations and the components are replaced with the non-super conducting materials. And the main demerits of this non-super conducting coils is it has the power loss which is negligible with the comparison of total power. The other structures which are introduced have two numbers of thyristor switches 1,2 in the AC branch of the diode bridge. Figure 1 shows the schematic diagram single line power system which is used in this paper. The low voltage side of the substation transformer is Y-connected and is grounded by means of a reactor of 0.01_ per phase 3.This grounding system limits over currents caused by single-phase-to ground faults. The high voltage side of the substation transformer is delta connected. At MV and LV sides of transformer, single line to ground fault (LG), double line to ground fault(2LG),double line to line fault (2L) and three line to line (3L) will be examined and the results can be evaluated.

Author for correspondence:
Associate Professor, Department of Electrical and Electronics Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem-636308, Tamil Nadu, India

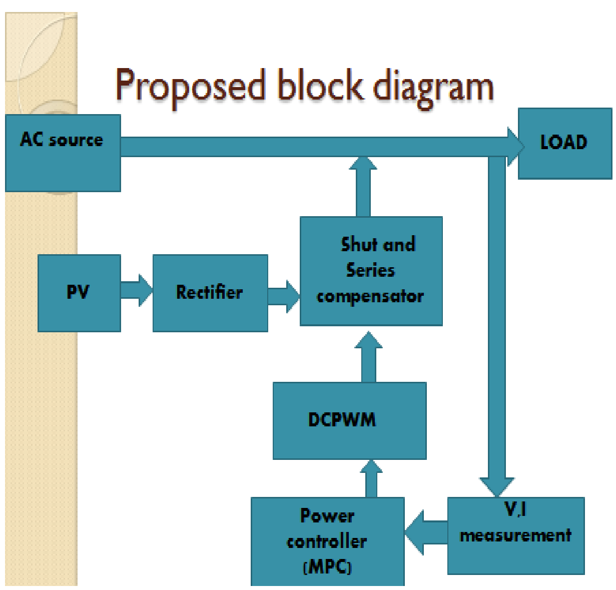
EXISTING BLOCK DIAGRAM



- In existing method PI control only used so its closed loop response is too slow, and not accurate.
- Voltage stability is low
- Here normal PWM is used so harmonics in solid state current limiter is high.
- Transient time for sag rectification is 10s to 1 minute.

An advanced design of VSI for a 3 phase 4 wire distribution systems is proposed in this paper. The proposed system has the capability to mitigate voltage and current related power quality issues with reduced dc link voltage rating. The fuzzy logic controller eliminates the drawbacks of MPC controller. MATLAB/Simulink shows the effectiveness of the proposed VSI system. From the results, it is clear that the proposed VSI system can compensate for voltage sag/swell, harmonics in voltage and current waveforms and reactive power, thereby making the load voltage balanced and sinusoidal.

PROPOSED BLOCK DIAGRAM



- Transient stability time of sag rectification is less then 1ms.
- MPC algorithm is used to calculate fault more accurate and fast so power factor is nearly unity.
- DCPWM is used so harmonics is less in solid state converter.

WORKING

Transient stability time of sag rectification is less then 1ms.MPC algorithm is used to calculate fault more accurate and fast so power factor is nearly unity. DCPWM is used so harmonics is less in solid state converter. This paper focuses on application of intelligent methods behind TCSC controller for Reactive power Compensation in an isolated hybrid system and enhancement of the stability of the system. A small signal linear model of the hybrid PV based micro grid model is considered and simulated for different solar insolations. Wind inputs and with uncertain loading conditions.

The reactive power control as well as the stability analysis have been carried out with TCSC Controller. A feed forward neural network with back propagation technique has been designed for tuning the parameters of TCSC controller. Simulation result verify the fact that the system parameters of TCSC controller. Simulation result verify the fact that the system parameters improve by the application of ANN and attend steady state value with lesser time and complexities.

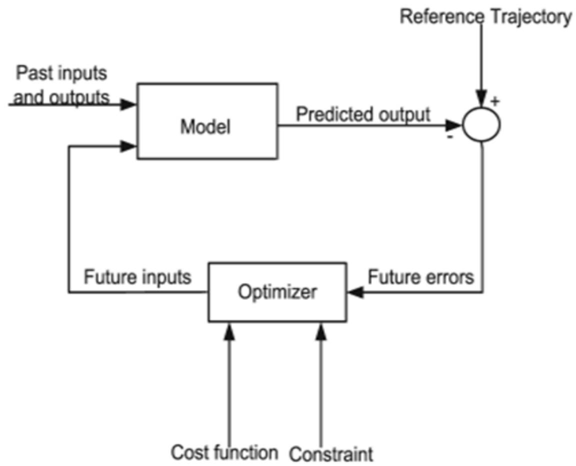
Power systems efficiency is always improved by the management of reactive power. Reactive power supports the voltage, which should be controlled for enhancing system reliability. Also reactive power has an effect on the voltage profile of the whole system. Voltage control is very important for the electrical power system as far as proper operation of electrical power equipment's like generators, motors are concerned. Control of reactive power and voltage stability help the power system in reducing transmission losses and prevent voltage collapse. The voltage profile of power system is controlled by the management of production and absorption of reactive power.

MODEL PREDICTIVE CONTROL (MPC)

MPC received a very favorable echo in the industry because it is recognized as a simple and effective control technique. It has proved to efficiently control a wide range of applications in industry, among them the chemical process that was the first application for this type of control, petrol industry, electromechanical systems like controlling robot axes and many other applications. It is capable to control a great variety of processes, including systems with long delay times, on minimum phase systems, unstable systems, multivariable systems, constrained systems and hybrid systems. The main idea of predictive control is to use a model of the plant to predict future outputs of the system. Based on this prediction, at each sampling period, a sequence of future control values is elaborated through an on-line optimization process, which maximizes the tracking performance while satisfying constraints. Only the first value of this optimal sequence is applied to the plant, the whole procedure is repeated again at the next sampling period according to the 'recoding' horizon strategy.

A simple block diagram characterizing the MPC is shown in Figure 1.It should be noted that the predicted output from the system model and the actual error are used to obtain the control signal. Model predictive controlis based on the system model and the principles of Receding Horizon Control (RHC).The control signal at instant is obtained by solving at each sampling instant, an on line open loop optimal control problem over a finite horizon using the current state of the system as initial stages. The interesting of this control technique becomes obvious when the trajectory to be followed by the system is known in advance, as for example in the robot, chemical process or machine tools, where the anticipation action takes place. The general object is to tighten the future output error to zero, with minimum input effort.

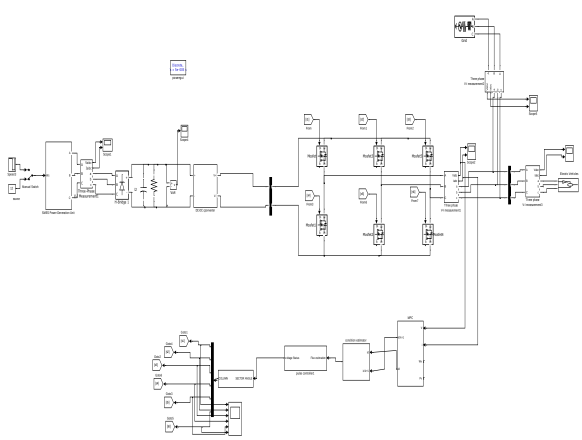
The cost function to be minimized is generally a weighted sum of square predicted errors and square future control values, e.g. in Generalized Predictive Control.



$$J(N_1, N_2, N_u) = \sum_{j=N_1}^{N_2} \beta(j)\left[\hat{y}(k+j) - w(k+j)\right]^2 + \sum_{j=1}^{N_u} \lambda(j)\left[u(k+j-1)\right]^2 \qquad (12)$$

where $N1$, $N2$ are the lower and upper prediction horizons over the output, Nu is the control horizon, $\beta(j)$,$\lambda(j)$ are weighting factors. The control horizon permits to decrease the number of calculated future control according to the relation: $\Delta u(k+j) = 0$ for $j \geq Nu$. $w(k+j)$ represents the reference trajectory over the future horizon N .Constraints over the control signal, the outputs and the control signal changing can be added to the cost function:

$$\left.\begin{aligned} u_{\min} &\leq u(k) \leq u_{\max} \\ \Delta u_{\min} &\leq \Delta u(k) \leq \Delta u_{\max} \\ y_{\min} &\leq y(k) \leq y_{\max} \end{aligned}\right\} \qquad (13)$$



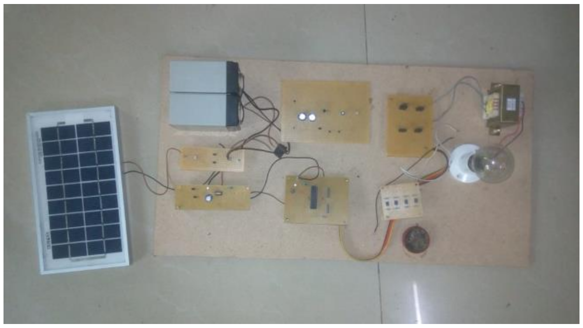
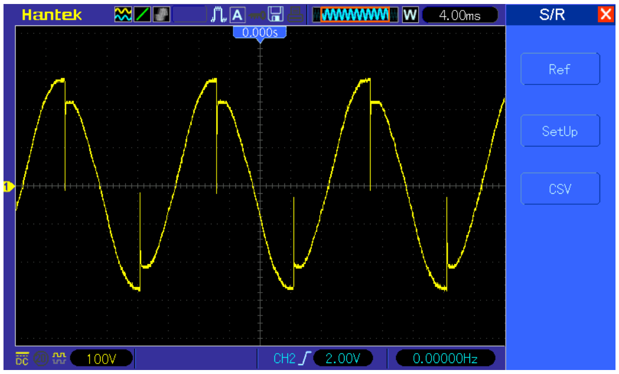


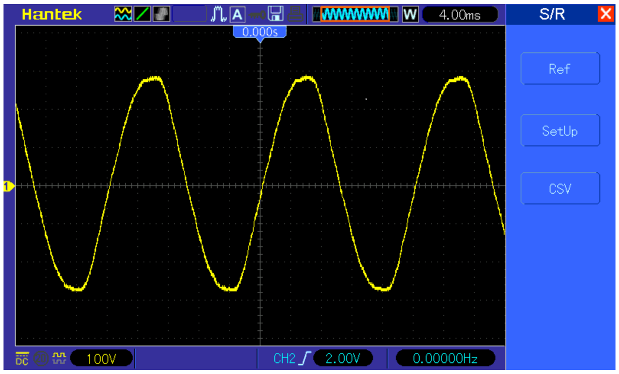
Fig.Hardware for Stability analysis in SMART GRID for Reactive Power Management Using PV

RESULT

Output voltage befroe reactive power management



Output voltage after reactive power management



CONCLUSION

An advanced design of VSI for a 3 phase 4 wire distribution systems is proposed in this paper. The proposed system has the capability to mitigate voltage and current related power quality issues with reduced dc link voltage rating. The fuzzy logic controller eliminates the draw backs of MPC controller. MATLAB/Simulink shows the effectiveness of the proposed VSI system. From the results, it is clear that the proposed VSI system can compensate for voltage sag/swell, harmonics in voltage and current waveforms and reactive power, thereby making the load voltage balanced and sinusoidal.

REFERENCES

[1]. Hingorani N .G , Gyugyi L ,Understanding FACTS, Concepts and Technology of Flexible AC Transmission System, NewYork, IEEE Power Engineering Society, 2000

[2]. Padiyar K.R, FACTS Controllering in Power Transmission system and Distribution, New Age International Publishers , 2008

[3]. Dong-Jing Lee and Li Wang, Senior Member, IEEE, Small Signal Stability Analysis of an Autonomous Hybrid Renewable Energy Power Generation/Energy storage system part I, Time domain simulations, IEEE Transaction for Energy Conversion, 23(1), 2000.

[4]. AE Hammad,M El Sadek, Application of Thyristor Controlled Var Compensator for damping Sub Synchronous oscillation in Power System, IEEE Transaction Power App System, 1984.

[5]. Nema Rajesh Kumar, Meikandasivam, S, Jain ,Shailendra Kumar. Selection of TCSC parameters capacitor and inductor Martin German- Sobek, _ubomír Be_a, Roman Cimbala Using of the Thyristor Controlled Series Capacitor in Electric Power System, ELEKTROENERGETIKA 4(4), 2011.

[6]. Mathur, R.M,Varma,R.K ,Thyristor-based FACTS Controllers for Electrical Transmission Systems. IEEE Press, Piscataway. 2002.

[7]. Garng Huang and Tong Zhu,TCSC as a Transient Voltage Stabilizing Controller. IEEE conference proceedings., 2001, 628-633.

[8]. Yunqiang Lu, Ali Abur, Static Security Enhancement via Optimal Utilization of Thyristor-Controlled Series Capacitors. IEEE Transactions on Power Systems. 17, 2002, 324-329.

[9]. Karami A, Power system transient stability margin estimation using neural networks. Int J Electr Power Energy Syst 33(4), 2011, 983–91 PI Controller ANN Controller Maximum Deviation Settling Time Maximum Deviation

[10]. Riedmiller M, Braum H. A direct adaptive method for faster back-propagation learning: the RPROP algorithm. IEEE Int Conf Neural Networks 1993, 586–9

[11]. Hagan MT, Menhaj M. Training feed forward networks with the Marquardt algorithm. IEEE Trans Neural Networks 1994;5(6):p. 989–93. [12] Jayabarathi.R.A, Devarajan. N,ANN based DSPIC controller for reactive power compensation, American journal of applied science 4(7), 2007, 508-515

[12]. IEA, Renewable Energy, Market and Policy Trends in IEA Countries, International Energy Agency, France, 2004.

[13]. Hagan, M.T, M.Menhaj, Training feed forward networks with the Marquardt algorithm. IEEE. Transaction on Neural Networks 5(6), 1999, 989-993.

[14]. Mohanty Asit, Viswavandya Meera, Ray Prakash K., Patra Sandipan, Stability analysis and reactive power compensation issue in a microgrid with a DFIG based WECS, Electrical Power and Energy System, 2014, 68-77.

[15]. Bansal, R.C, Automatic Reactive Power Control of Autonomous Hybrid Power System, PhD Thesis, Centre for Energy Studies IIT Delhi 2002.