

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: <u>www.ijirset.com</u> Vol. 8, Issue 6, June 2019

Simulation of Integrating Solar Photovoltaic Energy Sources in Smart Grid applications

Bharathy Priya D¹, Dr.A.Sumathi²

Research Scholar, Anna University, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India¹ Professor and Head, Department of Electronics and Communication Engineering, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India²

ABSTRACT: Smart Grid is an electrical Grid that communicate with us to manage our electricity consumption by creating network of communications that will control computers automation. It helps in utilizing energy conversion, reduction in cost, increase in reliability and more efficient. In Smart Grid applications, Solar and Wind energy production play an important role in Integrating Renewable Energy resources. Smart Grid technology enables by adding Sensors and Software's to the existing system that gives utilities and individual information to help them understand and react to changes quickly. Simulation results of solar photovoltaic energy systems are presented using MATLAB Simulink.

KEYWORDS:Solar Photovoltaic energy systems, Wind energy, Smart Grid, MATLAB Simulation

I. INTRODUCTION

Smart Grid is a modern electric power systems that used for communication network, sensors, automation. Smart grid is to promote active consumer participation and decision making as well as to create the operation environment in which both utilities and electricity users influence each other. Integrating modern digital electronics technology into the electrical power grid enables the utility to detect, monitor and respond digitally to any changes, thus making it a smarter version of the grid.

Benefits of Integrating Renewable energysystem

Smart grid technology helps to Integrating both small and large facilities. Renewable Generation will reduces the need for investments in grid reinforcement infrastructure, that will controls and operational metrics. Distribution level facilities provide energy security to limit the extent of a system disturbance and allow for faster recovery. grid technologies such as Advanced Meter Infrastructure, Advanced Electricity Pricing, Demand Response and Distribution Automation Resource Forecasting, Smart Inverters, Distributed storage, , Bulk power Technologies, also allow diverse and changing mix of Renewable energy system on the grid.[1]

Necessary for Integrating Renewable Energy Sources

- Advanced sensing systems, communicating and controlling method functionalities in the power grid's operation, for the purpose of enhanced efficiency, reliability, security and reduce in emission.
- Powergrids allows to support a greater percentage of variable renewable energy resources.
- More effectively and lowcost.
- As integrating renewable energy system increases, more advanced control system will be required to maintain reliability.[2]
- Reduce barriers in integrating renewable energy resources.



(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: <u>www.ijirset.com</u> Vol. 8, Issue 6, June 2019

II. SMART GRID SOLARPV RENEWABLE ENERGY SYSTEMS

Renewable energy resources and distributed generation systems are receiving support and their shares in generating electricity are rapidly rising. Lots of sensors and controls are used to re-route power to other power lines that is required from renewable energy resources, so that power can be transported to a greater distance whenever it is needed. Smart grid delivers electricity from suppliers to consumers using digital technology through control automation continuous monitoring and optimization of distribution system in order to save energy, reduces consumer cost and improve reliability. Smart Grid technology is to provide flexibility that need to integrate variable generation in characteristics of renewable resources such as Wind or Photovoltaic.

Solar Photovoltaic Smart Grid System

The Integration of systems into the electrical power grid with several technical problems like instability, energy quality degradation, signal parameter fluctuation and mismatch between loan supply and demand, Integrating decentralized renewable energy generators in co-generation seems to be the backing solution for the above stated problem.

Interleaved Dc-DC converter reduce the ripples in PV current without requirements of sizable or high switching frequency. The DC voltage on the inverter side of the DC-DC converter is normally maintained to be constant by the inverter control. The MPPT algorithm is used to find continually a PV array DC voltage which extracts the most power from the PV array while the cell temperatures and operating conditions of the module change. In P&O method, the terminal voltage of the PV array is perturbed in one direction and if the power from the PV array increases, then the operating voltage is further perturbed in the same direction. Filter is placed at the output to minimize harmonics fed into the power system. In some designs a transformer is also employed at the output of the inverter to ensure no DC is injected into the grid.



Figure 1: Block Diagram of Solar PV Grid System



(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: <u>www.ijirset.com</u>

Vol. 8, Issue 6, June 2019

Functionalities of Smart Grid

The main functionalities of Smart Grid in Renewable energy systems are

- Low cost reliable and quality with energy supply that can be archived through peak demand management, demand response control (with smart meters/AMI) and solar roof tops.- From the consumer perceptive of view
- Customer satisfaction with a margin of profit for continuous improvement of services for uninterrupted and secured energy delivery, that can be achieved by reducing energy losses, improving metering, billing and collection (MBC), outage reduction, efficiently using the asset (with AMI/DMS/OMS and IT Sustame). From the Distribution percenting of view.

Systems)- From the Distribution perceptive of view.

• Reliable and quality and secured generation and transmission to end customers through /Service

Providers, that can be achieved using efficient energy dispatch systems, mix of generation (conventional and renewable)(SCADA/EMS, WAMPAC/, IT system)- From the Transmission and Generating companies perspectives of view.

Features of a Smart Grid Technology

Figure 2 shows the key features of Smart Grid Technology. The key options of Grid technology are as follows:

- ✓ Enables participation by shoppers.
- ✓ Enables new product list, services and markets.
- ✓ Anticipates and responds to system disturbances in an exceedingly self -correcting manner.
- ✓ Operates resiliently against physical and -attack and natural.
- ✓ Provides power quality that meets a range of needs required by our new digital economy.
- ✓ Accommodating all generation and storage Integrating systems, monitoring merging, controlling, protection, maintenance, EMS, AMI etc.
- ✓ Having Plug-in and Play system features for work equipment and ICT based solutions.



Figure 2: Smart Grid Technology Features



(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: <u>www.ijirset.com</u>

Vol. 8, Issue 6, June 2019

III. LITERATURE SURVEY

Survey of integrating renewable energy system in smart grid application based on the characteristics as follows: merits and demerits of smart grid concept methods, optimization of renewable energy in smart grid system, pricing and forecasting strategy are as follows:

- In this paper, discussed about smart grid concept and applications with respect to designing, size and optimal placement of the energy mix, small scale test implementations in order to choose the best strategy to its implementation, voltage stability, overall system integration rate, global losses and many other factors which help economical and technical [7].
- Discussed key features of the smart grid by performing the smart demand response dispatching, survey of potentials and benefits when enabling technologies such as energy controllers, smart meters and communication systems. Implicitly promotes the reliability and sustainability of the power supply and lowering the peak demand.[5].
- Discussed solutions of the connection and the integration of renewable energy sources in the electric grid and their architectures.[3]
- smart grid application for renewable energy distributed generation, merits and demerits of renewable energy distributed generation is discussed in this paper.[12]
- Modeling of PV system, controller method used in PV and simulation of grid connected solar system is discussed in this paper [2].
- Discussed the issues of renewable energy sources from engineering's, energy supply and related environmental problems like global warming, health and economic perspectives [6].
- Improved power grid systems such as smart infrastructure system, the smart management system, and the smart protection system are discussed in this paper [8].
- Discussed the tools that are available for PV system design and sizing, problem arising from the system sizing and PV contribution to the load 13], [14].
- Discussed that the renewable energy sources provide reliable and comparatively low cost electricity services[9]
- Discussed about the allocation of renewable energy sources in smart grid system and optimal reactive power injection in order to improve the voltage stability of the system and the penetration level of renewable energy sources.[10]

IV. MATLAB SIMULINK RESULTS

Figure 3.Shows the Matlab Simulink circuit for grid connected solar photovoltaic systems for three phase home appliances. Figure 4. Shows the Simulink result of Inverter output voltage which is connected to the Grid for energy distribution systems such as Industry, home etc. requirements.



(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: <u>www.ijirset.com</u> Vol. 8, Issue 6, June 2019



Figure 3:MATLAB Simulink circuit for Grid connected Solar Photovoltaic system



Figure 4: Simulation results for output voltage of the inverter.



(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

V. CONCLUSION

This paper discussed, the key role of smart grid technology in renewable energy system which has a demanding and role in the future efficient power generation and distribution. Smart Grid technology used in various energy distribution systems, development in low cost smart meters. Integrating renewable energy sources is expected to be significant influence on the operation of the powersystem for sustainable energy in future work that involves- Distributed renewable interconnection technologies with advanced practicality, Integrating of renewable energy sources with load and storage, Electric power system technologies, controls and operations that enable high penetration of distributing renewable energy sources, models for renewable energy systems that allow them to be included in various planning and analysis tools

REFERENCES

- Ministry of New and Renewable Energy [2016], Annual Report 2016-2017, NewDelhi of New and Renewable Energy. [1]
- Ben , I., M., N., .., "Modeling, control and simulation of a grid connected PV system", IEEE 2014 International conference on Electrical [2] sciences and Technologies in Maghreb (CISTEM)April 2015
- Y.V., RavikumarBhimasingua "Key aspects of smart grid design for distribution Automation: Architecture and Responsibilities", Smart Grid [3] Technologies, Vol 21, pp.352-359, 2015
- J., J.A., M.A., A. "Analysis of massive integration of renewable power plants under new regulatory frameworks", IEEE conference on [4] Renewable energy research and application (ICRERA), October 2015
- PierluiglSiano, "Demand response and smart grids-A", Renewable and Sustainable energy reviews, vol 30, pp 461-478, 2014 [5]
- Abbas, SuardiSuhaimi, GholamrezaZahed, AlirezaBahadori, "A review on the drawbacks of renewable energy as a promising energy source [6] of the future", IEEE power and energy magazine 38, issue 2, pp 317-328 2013.
- [7]
- N., S., "Opportunities and challenges of integrating Renewable energy in Smart Grid System", energy, Vol.34, pp 282-290, 2013 Xi fang, SaptyajayantMisra, GuoliangXue, yang, "The New and improved power Grid: A ", IEEE communications and Tutorials, Vol 14, [8] No.4. 944-980, 2012.
- [9] V, S, G, MG, F, E, G. Smart renewable generation for an system. Technical and economic issues of future scenarios. Energy 2012;39(1);196-204
- [10] M H, Alvarez-Ortega C. Integration of renewable energy sources in smart grids by means of evolutionary optimization algorithms. Systems with Applications 2012;39 (5);5513-22
- [11] Steve G., Kelly Crandall, "chapter 1-Smart grid is a lot more than just technology", science direct, smart Grid, integrating Renewable, Distributed and efficient energy, pp3-28, November 2012
- [12] A, Weber K, Challenges and Integration of PV and Wind Energy Facilities from a smart Grid point of view. 2012;25;118-25.
- [13] A, T. Stand-alone PV system design: Results using a new sizing approach. Renewable Energy 2008;33(1):162-7
- [14] R, Lopez R, Approaches for developing a sizing method for stand-alone PV systems with variable demand. Renewable Energy 2008;33(5):1037-48
- [15] Mohamed, O. Mohammed and G. Roig, Efficient Integration of Renewable Energy to Smart Grid Power Systems, Tenth LACCEI Latin American and Caribbean Conference (LACCEI'2012) pp. 1-6.
- [16] R. Hidalgo, C. Abbey and G. Joos, Integrating Distributed Generation with Smart Grid Enabling Technologies, Innovative Smart Grid Technologies (ISGT Latin America), IEEE PES Conference (2011) pp. 1-7.
- [17] E. Natsheh, A. Albarbar and J. Yazdani, Modeling and Control for Smart Grid Integration of Solar /Wind Energy Conversion System, Innovative Smart Grid Technologies (ISGT Europe), 2nd IEEE PES International Conference and Exhibition (2011) pp. 1-8.
- [18] J. M. Carrasco, Power Electronics for the Integration of Renewable Energies into Smart Grids, Power Engineering, Energy and Electrical Drives (POWERENG), International Conference (2011) 1.
- [19] H. YuPin, Y. HongTzer, W. Chung Chi and C. JiannFuh, Implementation of a New High Step-up Dc-Dc Converter for Applications in Renewable Energy Conversion of a Smart Grid, Advanced Power System Automation and Protection (APAP), International Conference (2011) pp. 2140-2149
- [20] A. Kiani and A. Annaswamy, Distributed Hierarchical Control for Renewable Energy Integration in a Smart Grid, Innovative Smart Grid Technologies (ISGT), IEEE PES (2012) pp. 1-8
- [21] E. Bitar, P. P. Khargonekar and K. Poolla, Systems and Control Opportunities in the Integration of Renewable Energy into the Smart Grid, Proc. of IFAC World Congress (2011) pp. 4927-4932
- [22] L. H. Koh, Y. K. Tan, P. Wang and K. J. Tseng, Renewable Energy Integration into Smart Grids: Problems and Solutions- Singapore Experience, Power and Energy Society General Meeting, IEEE (2012) pp. 1-7