IMPROVING ENERGY MANAGEMENT FOR MICROGRID WITH SOLAR PV AND ENERGY STORAGE SYSTEM

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Abstract- Renewable energy sources have emerged as an alternative to meet the growing demand for energy, mitigate climate change, and contribute to sustainable development. The integration of these systems is carried out in a distributed manner via microgrid systems; this provides a set of technological solutions that allows information exchange between the consumers and the distributed generation centers, which implies that they need to be managed optimally. Energy management in micro grids is defined as an information and control system that provides the necessary functionality, which ensures that both the generation and distribution systems supply energy at minimal operational costs. This paper presents a literature review of energy management in micro grid systems using renewable energies, along with a comparative analysis of the different optimization objectives, constraints, solution approaches, and simulation tools applied to both the interconnected and isolated micro grids. To manage the intermittent nature of renewable energy, energy storage technology is considered to be an attractive option due to increased technological maturity,

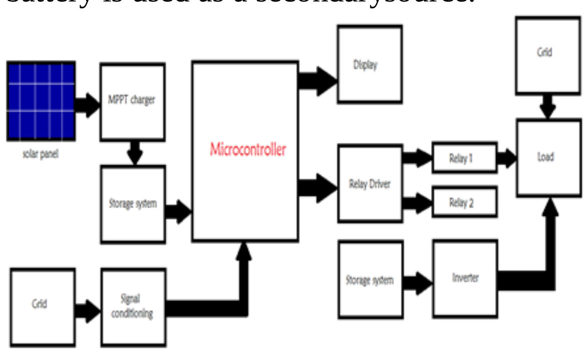
Index Terms- grid systems,

I. INTRODUCTION

In an attempt at getting the most of Solar PV Cell, MPPT is used to get the best operating point from V-I characteristics Curve. This is the location of V-I curve where voltage multiplied by current yield the highest value of power. MPPT allows an inverter to remain on the ever-moving maximum power of PV Module. Since sunlight intensity and PV Cell temperature vary considerably during the day and year, current and voltage also vary accordingly. Due to dependence on weather for Solar PV Energy sources, micro-grids with high Solar PV penetration are characterized by randomness and changeability. Solar PV generations are usually complemented by Storage System for stable and efficient power supply. Apart from storing the unused energy of Solar PV generation, storage system can assist Solar PV in meeting the grid active/reactive power demand. Employing Solar PV power sources requires complex control strategies to reduce power fluctuation and maintain stability. The control objectives for islanded micro grids and large AC power systems are similar More specifically, for any type of AC power system: (i) generation and demand must be constantly balanced, (ii) frequency must be regulated, and (iii) costs of generation must be minimized; importantly, all of these goals must be met without violating any power output limits of the generation units (Cady et al, 2014). However, integrating DERs and controllable loads within the distribution network introduces unique challenges to micro-grid management and control which the Microgrid Energy Management system (MEMS) has to deal with. Shi et al, 2014 discussed the role of EMS in micro-grid operation and listed four essential functionalities that a micro grid EMS must support: Forecast, Optimization, Data analysis, and Human-Machine Interface (HMI). Most research work on energy management focuses on different functionalities of EMS depending on its topology as some may not be ideal to support all the functionalities. Micro grid may contain multiple power electronics blocks connected to the system in parallel operation. These converters must be controlled to satisfy several essential Microgrid American Journal of Engineering Research (AJER) 2018 www.ajer.org Page 194 requirements, including reliability, voltage regulation, and power sharing. To address these challenges, several control approaches have been proposed. The control approaches can be divided into two classes based on their architectures: centralized and decentralized. Centralized strategy increases efficient energy management through high-level communications but is inadequate for microgrids requiring high reliability and scalability. Decentralized strategy, which is usually based on droop scheme in a local controller, has improved reliability and facilitated power-sharing without need for communication between components, although mode transition flexibility and optimized energy management are restricted. The focus of this paper is to ensure that voltage and frequency of a single-phase AC Microgrid with inverter connected Solar PV and Battery resides within predefined threshold while preventing overcharging andundercharging. Energy Management strategy is targeted at extending the life of the Battery and maintaining good voltage and frequency regulation by Droop Control of Inverter-based energy resources and dynamic switching of the Power Electronic Interface at varying operating conditions. Stable and efficient power supply from an exclusively renewable micro grid is difficult to achieve due to random and non-dispatchable nature of renewable energy source (RES). The intermittent nature of renewable generation and load variation causes fluctuation in the microgrid network.

II. METHODOLOGY/ PROPOSED SYSTEM

There are variety of topologies of converter connections to combine different power source devices and a load. The proposed system power electronic solution must be environment friendly, compact, reliable, flexible and efficient. In the proposed system, battery is used as a secondarysource.



Fig,1 Block Diagram

Solar energy is used as a source used to charge the battery. Initially the battery is fully charged, this fully charged battery will be used to operate the loads. Once the battery meets a value less than the threshold value then the load would work on grid which have a high charging rate and a very low discharging rate. Simultaneously, the solar energy will be used to charge the battery to its desired voltage level. MPPT charger is based on battery monitoring system (BMS) algorithm. It protects the battery from over charging and maintains charging discharging cycles. Microcontroller will decide which supply is available and operate load according to it. Display is used in the system which displays the voltage and current of the load.

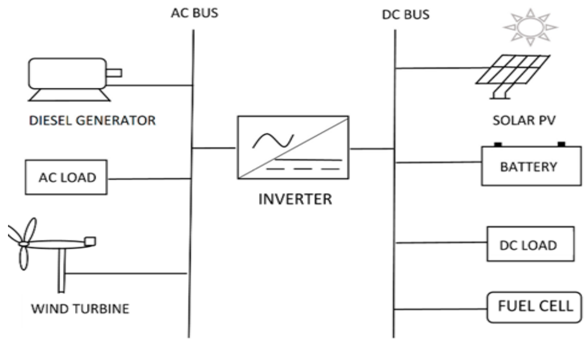


Fig.2

In a microgrid, it is essential to maintain the power supply-demand balance for stability because the generation of the intermittent distributed sources such as photovoltaic and wind turbines is difficult to predict and their generation may fluctuate significantly depending on the availability of the primary sources (solar irradiation and wind). The supply-demand balancing problem becomes even more important when the microgrid is operating in stand-alone mode where only limited supply is available to balance the demand. Energy management optimization in microgrids is usually considered as an offline optimization problemsoftware that permits the optimal operation of the system. This is achieved by considering the minimal required cost and two microgrid operation modes (isolated and interconnected). The variability resources such as solar irradiation and wind speed must be accounted for when considering microgrids with renewable energy sources.

III. LITERATURE REVIEW

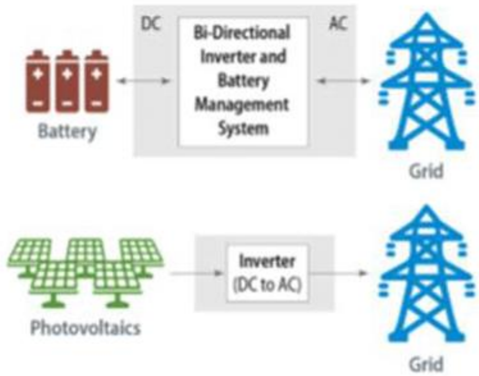
PV model was developed and verified with panel datasheet by fundamental equations and parameters from data sheet. Similarities of V-I curves for different condition with the corresponding curves in t KC200GT panel datasheet proved the validity of the developed solar panel model.

In order to complement Solar Photovoltaic Generation with energy storage system, various models of energy storage systemwere studied. The terminal Voltage, SOC, Open Circuit Voltage and demand Current of Battery/Ultra-capacitor can be calculated by the commonly used models. Charging/discharging efficiencies of ultra-capacitor is higher than that of Battery. While energy density is lower. S. Khalil and Khaled, in 2016 presented ultra-capacitor model developed from a two-stage ladder model, with RC equivalent Circuit as shown in figure.

Where Ut is terminal voltage, Uco is open circuit voltage, I is demand current, Rs is equivalent series resistance (ESR). SOC is estimated by integrating ampere-hour as shown in equation (1)

$$SOC = SOCo - \int_0^T \hbar I/Q \, dt \ldots\ldots\ldots(1)$$

SOCo is Initial value ofSOC; ɧ: ampere-hour efficiency of Uco ; Q is electric charge obtained from Q = C× Uco ;where C is capacitance and U is voltage.In 2006, Oureilidiset al modeled battery bank as variable DC voltage source in series with an internal resistance.According to the proposed model, the internal battery resistance depends on SOC and Temperature, while itsvalue differs between charging and discharging periods. The dependency of SOC with open-circuit Voltage wasillustrated with 2V Battery.



Economic performance of solar PV plus storage configurations were evaluated in southern California by considering each system's benefit/cost (B/C) ratio. Figure 3.0 provides schematic of independent PV and storage systems. These systems are not physically co-located and do not share common components or control strategies. As a result of being autonomous, storage systems respond to total grid conditions to provide peak capacity, shift energy from off-peak to on-peak periods, and provide ancillary services. The storage can charge with any grid resource that provides low-cost energy and discharge during periods of peak demand (when energy is most expensive). Because storage is not tied to a single energy source, it can charge from whatever source of energy that has the lowest operational cost, which maximizes its value to the grid. The Storage charges from PV Energy when it is most economical.

IV. CONCLUSION

The paper is related to improving energy management for microgrid with solar PV and energy storage system. The main advantage of this system is that hybrid system has more benefits of combining into series and parallel as a result they are more efficient and environment friendly. This system can be used on a large scale to produce electricity or used as an alternative source of energy in different applications. As in future various renewable energy sources such as wind energy, etc. can be used as secondary sources.

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