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A Review Article of Power Management in Pv-Battery-Hydro Based Stand Alone Microgrid

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***Abstract*- This works mainly on a Power Management System for a micro-grid system powered by a hybrid power generation system consisting of frequency control, power control, power management and solar photovoltaic (PV)- battery-hydro based micro-grid (MG) load. Therefore, power and frequency control allows for the balance of active energy and auxiliary services such as active energy support, source of current harmonics reduction and voltage reduction harmonics where common encounters.**

***Keywords*- Micro-grid, active energy, auxiliary services.**

I. INTRODUCTION

Due to the rapid depletion of petrol and pollution, people are now attracted to unconventional energy sources such as PV, wind, hydro, etc. Solar and wind energy resources are widely available worldwide. The natural variability of renewable energy from renewable energy systems is occasional.

The Conventional sources of energy are rapidly depleting. Moreover the cost of energy is rising and therefore photovoltaic system is a promising alternative. They are abundant, pollution free, distributed throughout the earth and recyclable. The hindrance factor is its high installation cost and low conversion efficiency. Therefore our aim is to increase the efficiency and power output of the system. It is also required that constant voltage is supplied to the load irrespective of the variation in solar irradiance and temperature.

PV (SG) arrays consist of parallel and series combination of PV (SG) cells that are used to generate electrical power depending upon the atmospheric conditions (e.g solar irradiation and temperature). So it is necessary to couple the PV (SG) array with a boost converter. Moreover our system is designed in such a way that with variation in load, the change in input voltage and power fed into the converter follows the open circuit characteristics of the PV (SG) array. Our system can be used to supply constant stepped up voltage to dc loads.

II. MICROGRID

Microgrid system operate at a low voltage distribution, and has several distributed energy resources. Microgrid system also has the ability to operate connected to the grid (on grid) or disconnected to the grid (off grid/islanded) [5].

Themicrogrid structure consists of several types of distributed energy sources (DER) such as solar panels, wind turbines, microturbin, thermal power plant each in the form of distributed generation (DG), including energy reserves from battery (Distributed Storage/DS).

Operation of microgrid system can not be separated from technologies that support from each part that make up the microgrid system, as the source of energy (distributed generation), energy storage, interconnect switches and microgrid control system. Technologies in energy sources distributed generation include the utilization of renewable energy sources such as photovoltaic, wind turbines, and fuel cells.

Control system inmicrogrid contrast to conventional power systems, this is due to several reasons, among others:

- Steady state and dynamic characteristics of microgrid different from conventional plants
- Microgrid possesses inherent unbalanced load due to one phase loads
- The supply of power from microgrid can come from uncontrolled sources such as wind
- The role of energy storage is very large in the control mechanisms used
- Microgrid accommodate disconnection and connection mechanisms to maintain expenses during its operating
- Microgrid requires initial requirements of power quality or service preferences for certain types of loads.

As a new paradigm of power systems, implementation of microgrid stil face many obstacles. Less understanding about microgrid and unfavorable government policies

become an obstacle in applying microgrid technology. In general, in addition can be applied as a solution to electricity in remote areas, microgrid technology can also be used as electrical solutions such as urban residential complexes, offices, schools and others.

In which implementation of microgrid technology will provide advantage ascompared to traditional technology if we have to build a new transmission and distribution network.

1. Microgrid Advantages:

- Microgrid, have ability, during a utility grid disturbance, to separate and isolate itself from the utility seamlessly with little or no disruption to the loads within the Microgrid.
- In peak load periods microgrid can prevents utility grid failure by reducing the load on the grid.
- Microgrid has environmental benefits made possible by use low or zero emission generators.
- In microgrid to increase energy efficiency, the use of both electricity and heat is permitted to get closer the generator to user.
- Microgrid can act to mitigate the electricity costs to its users by generating some or all of its electricity needs.

2. Microgrid Disadvantages:

- In microgrid, controlled voltage, frequency and power quality parameters are must be considered within acceptable standards whilst the power and energy balance is maintained.
- Electrical energy needs to be stored in battery banks thus requiring more space and maintenance.
- The difficulty of resynchronization with the utility grid.
- Microgrid protection is one of the most important challenges facing the implementation of Microgrids.
- Issues such as standby charges and net metering may pose obstacles for Microgrid.
- Interconnection standards need to be developed to ensure consistency. IEEE P1547, a standard proposed by Institute of Electrical and Electronics Engineersmay end up filling the void.

3. Future Direction on Microgrid Research:

- Future direction which require further investigation in the context of microgrid research are [10]:
- To investigate full-scale development, field demonstration, experimental performance evaluation of frequency and voltage control methods under various operation modes
- Transition between grid connected and islanded modes on interaction phenomena between distribution generation and high penetration of distributed generation
- Analysis the issue of black starting in an unbalanced system on the control, protection and power quality
- Transformation ofmicrogrid system today into the intelligent, robust energy delivery system in the future by providing significant reliability and security benefits.

III. RENEWABLE ENERGY

Renewable energy sources also called non-conventional type of energy sources which are continuously replenished by natural processes. Such as, solar energy, bio-energy - bio-fuels grown sustainably, wind energy and hydropower etc., are some of the examples of renewable energy sources. A renewable energy system convert the energy found in sunlight, falling-water, wind, sea-waves, geothermal heat, or biomass into a form, which we can use in the form of heat or electricity. The majority of the renewable energy comes either directly or indirectly from sun and wind and can never be fatigued, and therefore they are called renewable [2].

However, the majority of the world's energy sources came from conventional sources-fossil fuels such as coal, natural gases and oil. These fuels are often term non-renewable energy sources. Though, the available amount of these fuels are extremely large, but due to decrease in level of fossil fuel and oil level day by day after a few years it will end. Hence renewable energy source demand increases as it is environmental friendly and pollution free which reduces the greenhouse effect [1-2].

IV. SOLAR ENERGY

Solar energy is a non-conventional type of energy. Solar energy has been harnessed by humans since ancient times using a variety of technologies. Solar radiation, along with secondary solar-powered resources such as wave and wind power, hydroelectricity and biomass, account for most of the available non-conventional type of energy on earth. Only a small fraction of theavailable solar energy is used [3].

Solar powered electrical generation relies on photovoltaic system and heat engines. Solar energy's uses are limited only by human creativity. To harvest the solar energy, the most common way is to use photo voltaic panels which will receive photon energy from sun and convert to electrical energy. Solar technologies are broadly classified as either passivesolar or active solar depending on the way they detain, convert and distribute solar energy.

Active solar techniques include the use of PV (SG) panels and solar thermal collectors to strap up the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties and design spaces that naturally circulateair [5].Solar energy has a vast area of application such as electricity generation for distribution, heating

water, lightening in building, crop drying etc. Solar energy and gravitational energy are the fundamental sources of energy for the Earth's climate system.

In the ideal case (referred to as "black body") matter will absorb all the energy impinging on it in the form of electromagnetic waves and as a result will warm up and itself become a radiation source. This "give and take" of energy leads to a state of equilibrium, where the outgoing radiation balances the incoming one.

The energy radiated from a black body is distributed over all wavelengths, in a "bell-shaped" dependence on the wavelength. Maximum energy is radiated at a wavelength proportional to the inverse of the absolute temperature.

The total (integral over all wavelengths) energy radiated from a black body is proportional to the fourth power of its absolute temperature.

Following problem identify photovoltaic (PV) -battery-hydro based micro-grid given blow as-

- Variation of solar power fluctuations.
- Power compensation problem.
- Solar irradiation continuity problem.
- Grid Fault effect detection problem.
- Load balancing problem in micro grid.

V. LITERATURE REVIEW

D. S. CHAUDHARI: The solar photovoltaic is considered to be the one of the most promising energy source in many applications, due to its safety and high reliability. Residential that uses solar power as their alternative power supply will bring benefits to them. In order to increases the efficiency of system during rapid changing environmental conditions; system will adapt some Maximum Power Point Tracking (MPPT) methods. This paper presents a review on various MPPT methods for variable environmental conditions (i.e. variable temperature and irradiation level), their difficulty while tracking and how those difficulties can be overcome efficiently by the other techniques. Apart from all the methods, an open circuit and slope detection tracking technique is found to be an efficient technique with respect to tracking speed and accuracy. This technique can avoid the unnecessary amount of power loss and therefore maintaining the power efficiency.

PAWAN D. KALE: These modern days that consume a lot of energy e.g. fuel-oil, gas, coal etc. that will deplete in its source one day so, much of the focus have been given on the topic of renewable energy. Renewable energies are energy that can be renewed or have no worries of depletion. For instance wind, thermal, bio-mass and solar energy are some of the examples for renewable energy [1]. Solar energy is one of the main renewable energy sources that are widely used in power generating application. Solar energy is an unlimited resource available in nature and set to become important in longer terms for providing heat energy and electricity to the user. This kind of energy resources does not create much pollution as the conventional power sources moreover it has the potential to be the major energy supply in future [1], [8].

In the last decade, there was a consistent development in the worldwide market of photovoltaic (PV SMART GRID) system. By the end of 2008, 13 GW of energy had been generated by the installed PV (SG) systems throughout the world. Out of the total system installed 6% were standalone systems, 33% were grid-connected centralized systems, and 61% were grid-connected distributed system. In 2008 alone, photovoltaic systems which generate up to 5.56 GW energy were installed. This represents the growth in PV (SG) systems increased by 1.5 times as compared with the previous year.

GHISLAIN REMY: This paper presents a review of maximum power point tracking (MPPT) techniques for photovoltaic systems (PV SMART GRID). After a brief introduction of the key factors for the power extraction of photovoltaic panel, a review of the commonly used MPPT techniques is presented and detailed with an overall approach. Then, a comparison of the main industrialized ones is discussed for a photovoltaic system. In the last part, the pros and cons of each of the considered MPPT techniques are presented.

MOHAMED AZAB: In this paper a new maximum power point tracking algorithm for photovoltaic arrays is proposed. The algorithm detects the maximum power point of the PV SMART GRID. The computed maximum power is used as a reference value (set point) of the control system. ON/OFF power controller with hysteresis band is used to control the operation of a Buck chopper such that the PV (SG) module always operates at its maximum power computed from the MPPT algorithm. The major difference between the proposed algorithm and other techniques is that the proposed algorithm is used to control directly the power drawn from the PV SMART GRID. The proposed MPPT has several advantages: simplicity, high convergence speed, and independent on PV (SG) array characteristics. The algorithm is tested under various operating conditions. The obtained results have proven that the MPP is tracked even under sudden change of irradiation level.

M. S. SIVAGAMA SUNDARI: Energy especially alternative source of energy is vital for the development of a country. In future, the world anticipates developing more of its solar resource potential as an alternative energy source to overcome the persistent shortages and unreliability of power supply. In order to maximize the power output the system components of the photovoltaic system should be optimized. For the optimization maximum power point tracking (MPPT) is promising technique that grid tie inverters, solar battery chargers and

similar devices use to get the maximum possible power from one or more solar panels. Among the different methods used to track the maximum power point, Perturb and Observe method is a type of strategy to optimize the power output of an array.

In this method, the controller adjusts the voltage by a small amount from the array and measures power, if the power increases, further adjustments in that direction are tried until power no longer increases. In this research paper the system performance is optimized by perturbs and observe method using buck boost converter. By varying the duty cycle of the buck boost converter, the source impedance can be matched to adjust the load impedance to improve the efficiency of the system. The Performance has been studied by the MATLAB/Simulink.

SALEH ELKELANI BABAA: Maximum power point tracking (MPPT) controllers play an important role in photovoltaic systems. They maximize the output power of a PV (SG) array for a given set of conditions. This paper presents an overview of the different MPPT techniques. Each technique is evaluated on its ability to detect multiple maxima, convergence speed, ease of implementation, efficiency over a wide output power range, and cost of implementation. The perturbation and observation (P & O), and incremental conductance (IC) algorithms are widely used techniques, with many variants and optimization techniques reported. For this reason, this paper evaluates the performance of these two common approaches from a dynamic and steady state perspective.

TING-CHUNG YU: The purpose of this paper is to study and compare three maximum power point tracking (MPPT) algorithms in a photovoltaic simulation system. The Matlab/ Simulink is used in this paper to establish a model of photovoltaic system with MPPT function. This system is developed by combining the models of established solar module and DC-DC buck-boost converter with the algorithms of perturbation and observation (P&O), incremental conductance (INC) and hill climbing (HC), respectively. The system is simulated under different climate conditions and MPPT algorithms.

ROBERTO FARANDA: Many maximum power point tracking techniques for photovoltaic systems have been developed to maximize the produced energy and a lot of these are well established in the literature. These techniques vary in many aspects as: simplicity, convergence speed, digital or analogical implementation, sensors required, cost, range of effectiveness, and in other aspects. This paper presents a comparative study of ten widely-adopted MPPT algorithms; their performance is evaluated on the energy point of view, by using the simulation tool Simulink, considering different solar irradiance variations.

ALI BAHRAMI: In this paper, the effects of antireflection coatings on the performance of GaAs solar cells are theoretically investigated. Also, the conversion efficiency, short circuit current and open circuit voltage of the solar cell are calculated in various thicknesses and refractive indices of coating materials. Single and double layer coatings are utilized in order to achieve the highest performance. Simulation results show an optimum point for the thickness and refractive indices of the materials used as single and double layer antireflection coatings. Finally, 16.97% conversion efficiency, 27.91mA short circuit current and about 0.944V open circuit voltage are achieved for GaAs single cell with a low 5nm TiO2 thickness in Al2O3/TiO2 double layer coating. But the lower thickness of TiO2 increases the incident angle dependency of the reflectance.

SHAHRAM MOHAMMADNEJAD: In this paper, GaAs solar cell was investigated with different cases of single and double layer antireflection coatings. Single layer coatings show an ideal point that gives the maximum power conversion efficiency. The available materials with the refractive indices near the optimum case of single layer ARC can be Al2O3 and TiO2. Therefore, the combination of these materials has been utilized as the double layer coating. Simulation results for the different thicknesses of them show an improvement for Al2O3/ TiO2 double layer coatings with 5nm TiO2 thickness in comparison with single layer coatings. Also, it has been deduced that the higher percentage of TiO2 in double layer ARC decreases the dependency of the reflectance on the incident angle.

SMITHA KRISHNA MURTHY: Renewable energy is considered to be one of the most promising alternatives for the growing energy demand in response to depletion of fossil fuels and undesired global warming issue. With such perspective, Solar Cells and Fuel Cells are most viable, environmentally sound, and sustainable energy sources for power generation. Solar and Fuel cells have created great interests in modern applications including distributed energy generation to provide clean energy.

VI. CONCULUSION AND FUTURE SCOPE

In this system model enhanced all system performance and achieve lower power fluctuation situation using PV and Hydro microgrid. In this grid improvement of power quality and power synchronization using VSC fact device and feedback system.

This Thesis presents an overview of MPPT methods, and considers their suitability in systems which experience a wide range of operating conditions. From this, it is clear that each MPPT method has its own advantages and disadvantages and the choice is highly application-dependent. When using solar panels in residential locations, the objective is to reduce the payback time. To do so, it is necessary to constantly and quickly track the

maximum power point. Furthermore, the MPPT should be capable of minimizing the ripple around the MPP. Therefore, the two techniques stages—incremental conductance (IC) and perturbation and observation (P & O) algorithms are suitable. These two methods have been evaluated by simulating a standalone PV (SG) system, utilizing a DC-DC boost converter to connect the PV (SG) panel to the load. In particular, the performance of each method has been considered over a wide range of different irradiation conditions. Results show that the enhance of perturb and observe algorithm exhibits faster dynamic performance and achieves steady state level better than the incremental conductance method over a broad range of irradiation settings and load profiles.

In this Thesis, a general presentation of the photovoltaic systems and its components has been made. Models have been analyzed regarding the MPPT interaction. Various MPPT Techniques have been described and simulated. Some comparisons of MPPT's have been presented on: The requested sensors, which give an indication on the MPPT cost; The response time to a Solar irradiance step; The performance of MPPT's for a 2 PV (SG) series structures; Some drawbacks of each MPPT technique.

Finally, among the compared MPPT Method, Perturb & Observe Method seems the most use. Indeed, the P&Ob is the fastest and stable, due to his variable perturbing value. Furthermore, the Three-Point Weighted (P&Oc) is the most robust, due to an equivalent 2nd order Gradient approximation. Precisely, even if the P&Oc responses are very slow compared to P&Ob, simulation results show that only the P&Oc is able to obtain the Maximum Power Point, if two panels are connected in series with different solar irradiance.

VII. FUTURE WORKS

In this, Due to usage of PI controller some loss incurred at output/load side, to eradicate the loss we can use for future expansion and thus approximate values with less tolerance can be acheived.

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