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Protection of DC-DC Microgrid

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***Abstract*:- Microgrid has assumed a vital part in lessening the effect of distributed generation, and subsequently turns into a compelling and productive methods for advancing sustainable power use and improving the quality power supply unwavering quality. Microgrid alludes to a little energy supply framework for the most part includes distributed generation, monitoring and protection device, storage device, load, energy conversion device.**

It is equipped for both integrated and island operation, and can be perceived as a free control unit comparative with the grid.

Keywords—Microgrid; microgrid protection; DC microgrid.

I. INTRODUCTION

The microgrid is built of small groups of loads with small scale electric power source. The microgrid can be associated or segregated from grid according to put while, most extreme microgrid are associated with grid. In this way the microgrid give greater adaptability to stay away from grid operation, it tends to be handily introduced at any far off put and work as off grid microgrid [7]. As sun light is accessible all over the place along these line sunlight-based PV can without much of a stretch offer inventory to microgrid.

Different MPPT assists with improving effectiveness of sun based PV in which the perturb and observe (P&O) Maximum power point tracking (MPPT) is generally normal and effective among other MPPT. The P&O is utilized to give gate pulse to DC-DC boost converter for supplying steady voltage to the grid.

One of the vital components in a microgrid is its protection system. A microgrid works in two different modes for example grid connected mode and standalone mode, detached by a point of basic coupling (PCC). The acknowledgment of fault in microgrid and main grid is done in both operating modes, and isolation happens by means of PCC and reconnecting it to the main grid after the fault is cleared[2].

Quite possibly the main changes that a power system is encountering is the infiltration of distributed energy resource (DERs) into distribution network. A microgrid coordinates the DERs in a efficient, cost effective, and eco-friendly way. A microgrid is a small scale sustainable electric distribution system that contains DERs, energy stockpiling system, and controllable loads. Microgrids can be associated in standard parallel with the main grid or be worked freely in the islanded mode [1,2]. microgrids are required for the improvement of reliability, consistent operation of electrical power system, and power quality just as diminish power losses [3]. In any case for certain significant difficulties from protection and control aspects are related with the operation of microgrid. [4,5].

The aim of this paper is to propose and implement a centralized protection scheme to cater varying fault level. To the best of our knowledge, The organization of the paper is as follows. Section III illustrates system modeling in MATLAB/Simulink, whereas Section IV explains unified protection scheme. Simulation results are discussed in Section V.

II. PROTECTION CHALLENGES

Adaptation and intelligent techniques of protection needed for the brought-up issue on the integration of microgrids into the main grid [3–5]. The specialized difficulties that should be overcome in the design of the system for the protection of the microgrid and to enable it to operate successfully are as follows:

A. Bidirection Current Flow

The combination of the microgrid with the main distribution network, for providing the energy supply to local loads in the microgrid; and can also export energy to the network when there is an increase in the production of energy, which makes the power flow in the opposite direction [5].

B. Frequent changes in Microgrid Configuration

These progressions are either the result of the connection or disconnection of branches in the network. The current magnitude faults could be influenced by any changes in the configuration of the microgrid. The frequent changes in the short-circuit fault current make OC relays more muddled. These relays must modify their tripping characteristics immediately with respect to any change in the configuration of the network [4–5].

C. Reduction in Short Circuit Fault Current Level

The fault current at the main grid and the microgrid lessens the fault current for any relay. Besides, DG is based on converter power electronics restricts the level of short circuit fault current, particularly in the operation of the island mode [4-5].

D. Selectivily and Sensitivily of an Overcurrent Relay

The protection system should be able to differentiate main grid and the microgrid faults [8–11]. At the point when faults are in the main grid, it is necessary to carry out islanding to protect the microgrid. When faults occur, the protection system should isolate only the faulted section. Thus, the protection system should have the ability to operate selectively concerning any faults or disconnect the faulted section. The sensitivity of the relay must be adjusted without influencing the selectivity of the protection system.

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E. Fast and Reliable Communication in the case of Adaptive Protection system

This is the main problem in the design of the protection system microgrid. Require to be screen on the web and computation of short circuit fault current level for each small change in the configuration of the grid is important for the proper adaptive functioning of any protection system. This requires the application of a fast and reliable method and robust communication with a backup system [13–14].

III. MPPT TECHNIQUE

Photovoltaic (PV) generation addresses as of now quite possibly the most promising source of renewable energy. Because of that ecological and monetary benefits, PV generation is liked over other renewable energy sources, since they are clean, inexhaustible and require little maintenance. PV cells generate electric force by straightforwardly converting solar energy over to electrical energy. PV panels and arrays, generates DC power.

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For each PV system, there is a particular operating point labelled as MPP in I-V and V-P curves for each temperature and irradiation condition. The maximum power point (MPP)changes its position with any change in barometrical conditions. Therefore, the tracing system was intended to keep tracking MPP, and because of that they are an essential piece of the PV system. The controller changes the resistance seen by the panel, and thus forces the panel to work nearer to MPP. The general system as shown in Figure.1.

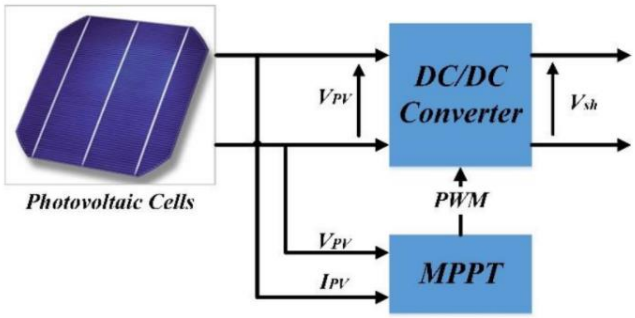

Figure 1 Block Diagram of PV System

There are different MPPT techniques used for maximum power tracking. They are as follows:

1. Permutation and Observation(P&O) Method.
2. Incremental Conductance (IC) Method.
3. Constant Voltage (CV) Method.
4. Fractional Open-Circuit Voltage (FOCV) Method.

Figure 2 is show the P&O algorithm reliant on increasing or decreasing the terminal voltage, or current, of the array at normal period and afterward taking a gander at the output power of the PV with the past example point [6].

Based on the basic mathematical condition (dP/dV = 0),Figure3 shows the process of MPPT system. when the PV array exhibit for the right area of the MPP curve, the output power will decrease with the increase in voltage and output power increase with the increase in voltage when the equivalent works for the left area of the MPP Curve. Henceforth if dP/dV> 0, the system keeps the disturbance, and if dP/dV < 0, the disturbance influence ought to be reversed.

The cycle rehashes until the operating point is across to the maximum power point. Where P and V are power and voltage at output of PV module respectively. principle benefit of the P&O algorithm is its simplicity. In general, this method shows a good operation provided the solar radiation doesn't stray excessively fast. The classic perturb and observe (P&O) method has the disadvantage of poor efficiency at steady state and low irradiation, the operating point oscillates around the MPP voltage (usually fluctuates lightly) but never reaches

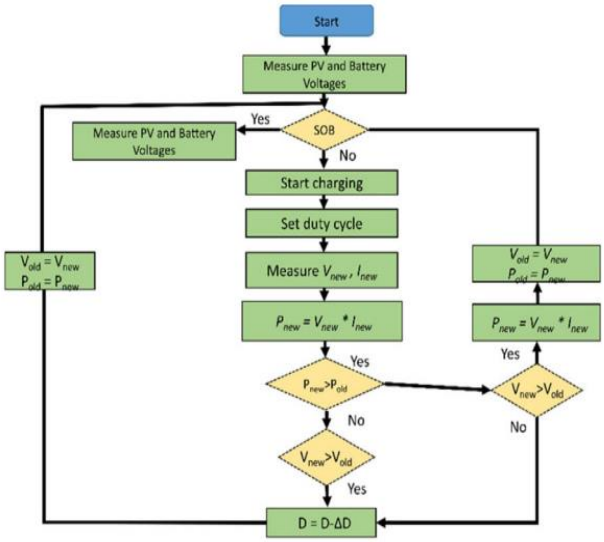

Figure 2 Perturbation and Observation method flowchart

The curve has three significant parameters specifically open circuit voltage (Voc), short circuit current (Isc) and maximum power point (MPP).

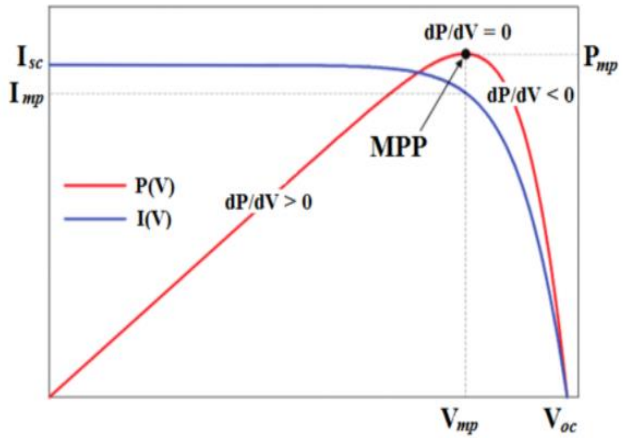

Figure 3 I-V & P-V curve of PV system

The I-V curve of the photovoltaic device relies upon the internal characteristics of the device and on external influences such as irradiation level and the temperature. The P-V curve of the Photovoltaic cell relies upon the open circuit voltage (Voc), the short circuit current (Isc) and the maximum power point (MPP).

International Journal of Engineering Research & Technology (IJERT)
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IV. SIMULATION

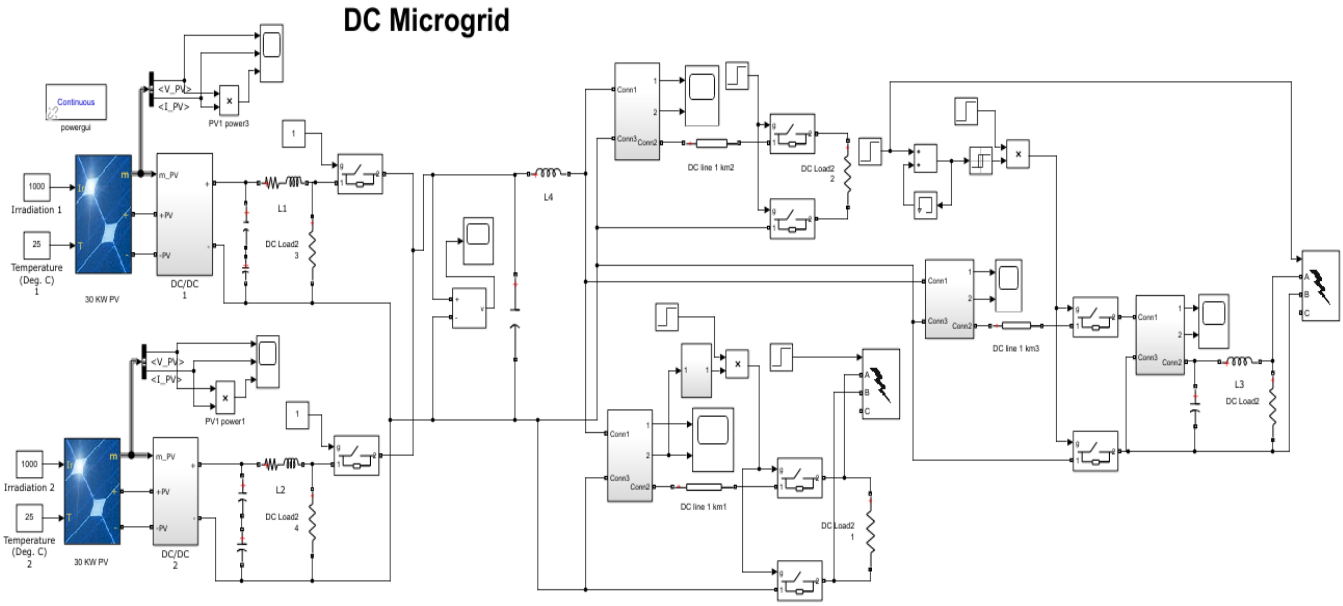

Figure 4 Simulation of DC Microgrid

Figure 4 shows the simulation model of a DC microgrid with a relay as a protection system. PV is taken as a source for DC Microgrid with 1000W/m^2 and temperature of 25^{o}C. Then PV is connected to the DC-DC converter.

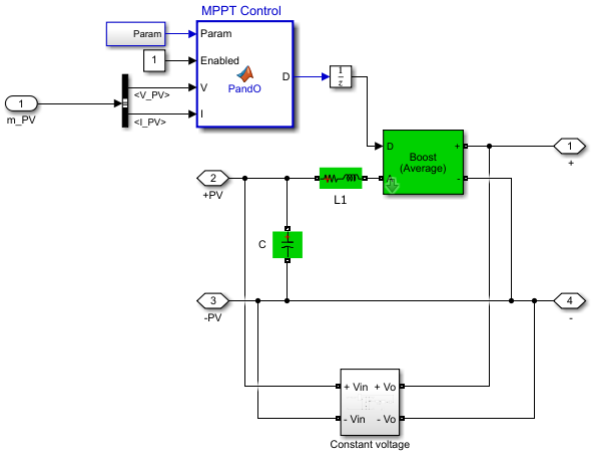

Figure 5 Simulation model of MPPT with Boost Converter

The perturb and observe MPPT technique is characterized as an algorithm and initially, 0.45 is given for starting the loop and afterward its change to accomplish maximum power point of solar PV with respect to its irradiation and temperature. Fig 6 show that MPPT is connected with boost converter which boosts voltage to accomplished voltage on which solar PV work on its full efficiency

The P&O method is utilized on the grounds that it is one of the easiest MPPT methods among others. The fuzzy logic can be the next viable method to change the P&O technique.

This converter provides constant 120V DC (± 5%) to DC microgrid regardless of voltage on DC bus varies between 100V to 210V. The tuned LC filter is utilized to smother switching harmonics on both sides of the converter.

After that 1km, DC lines are given where the fault is shown and the Circuit breaker is used.

V. RESULT

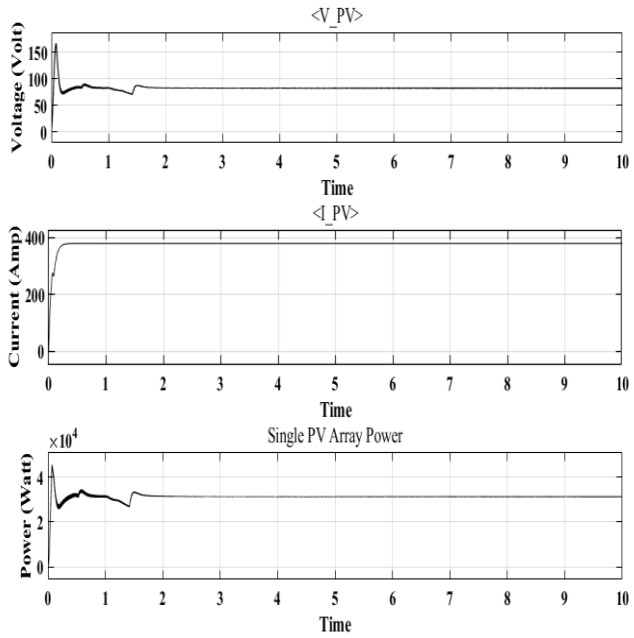

Figure 6 Voltage, current, and power waveform of PV Array

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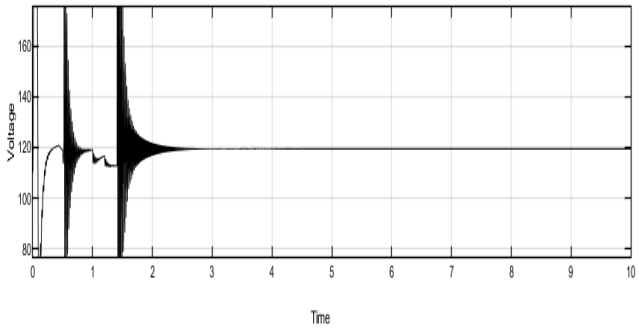

Figure 7 Constant 120V after DC-DC converter

Figure7 shows when the Load switches voltage drops. Oscillations are seen due to the presence of Load. PID takes time to read constant 120v.

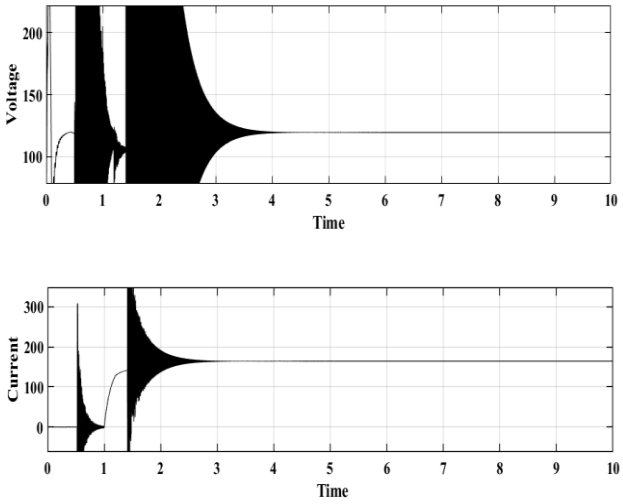

Figure 8 Voltage and current waveform of Line 1

Figure 8. shows the First distribution line does not include any fault .so it gives 120V voltage and 180A current.

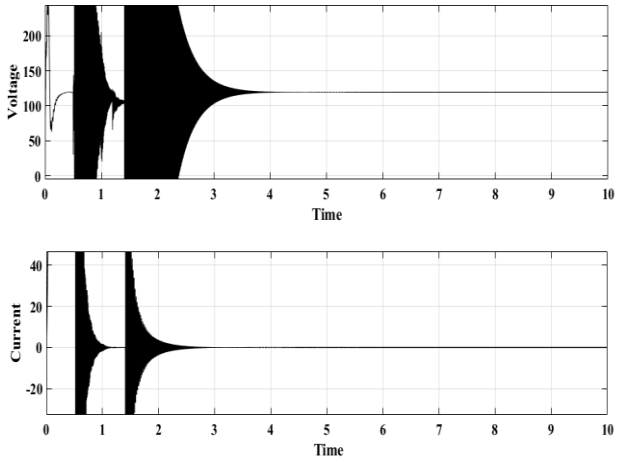

Figure 9 Voltage and current waveform of Line 2

Figure 9. shows the Second distribution line includes a fault and a relay also called a fuse. Current in the waveform which initially had a value becomes zero after 2 sec. This indicates the faulty condition.

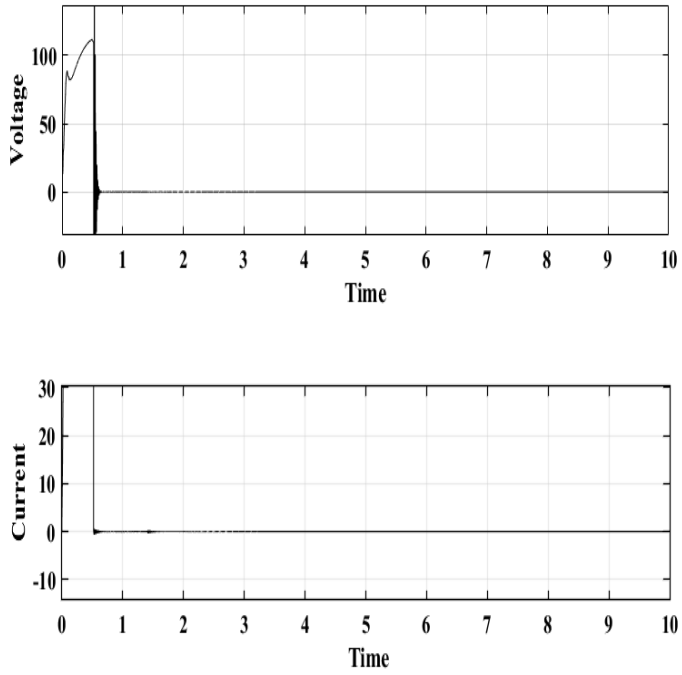

Figure 10 Voltage and current waveform of Line 2 after

Figure 10. shows the result of the second line in which Voltage and current both becomes zero. The circuit becomes a short-circuited

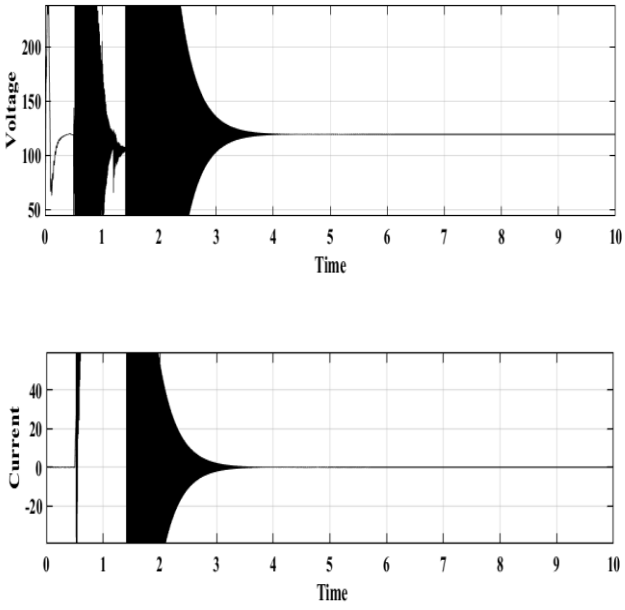

Figure 11 Voltage and current waveform of Line 3

Figure 11. shows the result of the third distribution line include a fault and relay. In this input current is compared with the nominal current and if it exceeds that current, fault

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takes place. Current in the waveform which initially had a value becomes zero after fault current detection. This indicates the faulty condition.

VI. CONCLUSION

Microgrid offers a catalyst to the use of renewable sources of energy. Reliability is accomplished on the grounds that decentralization of supply. In an occasion of power grid failure Microgrid is most likely the best other option. transformation of Microgrid system today into the intelligent, robust energy conveyance system later on by giving significant reliability and security benefits. Soon when the cost of the Microgrid system will be reasonable then Microgrids will end up being more famous and the conventional grid will be supplanted by Microgrid. Exploration going, for example, to expand stability and reliability of the Microgrid for effective working. Fuzzy can be present for basic intelligent control and for expanding the reliability of Microgrid.

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