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Simulation Analysis on Integrated Control and Protection System for Photovoltaic Microgrids

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Abstract **- The microgrid has shown to be a promising resolution for the integration and management of intermittent renewable energy generation. This paper appearance at vital problems surrounding microgrid control and protection. It proposes an integrated control and protection system with a hierarchical coordination control strategy consisting of a complete operation mode, a grid-connected operation mode, and transitions between these 2 modes for a microgrid. This approach provides a lot of reliable and strong grid because the systems will supplement one another. However, protection and control in a much meshed power network setup may be a challenge. this is often because a meshed microgrid has a lot of interconnections.**

Keywords**:** Control strategies, integrated protection, microgrid, operation modes**.**

I. INTRODUCTION

Electric power systems experience abnormal conditions like faults and disturbances which lead to power interruptions, loss of stability and blackouts. To prevent or at least minimize the fault consequences, a protection system is designed, installed and adjusted. Protection system consists of different types of relays that have different characteristics and functions. Relays are characterized according to their algorithms. Some are operated by high current values like over current relay, some by under and over voltage or frequency, and others by impedance like distance relay. The requirement of redundancy is widespread in protection system. Hence, it is common to protect equipment using more than one kind of relays. For example in transmission lines the distance protection is the main and over current is the backup protection. Redundancy is applied to equipments in high and medium voltage networks but not to low voltage networks. Communication channels are normally combined with protection systems of the high and medium voltage networks. Power line carrier (PLC) and fiber optics communication systems are common in power system networks. The modern protection systems use the telecommunications for activating more functions in relays in the network. For instance, the line differential relay uses communication channels (like fiber optics) to receive measurement information and send trip signals to the remote end.

Deep understanding of basics and theories is very important to dealing with the distribution system protection problems. Protection system is a complex system since it is affected by most of changes and events in network, such as configuration changes, equipments outages, faults, loading, and power system stability issues. As a result, protection engineers are following different protection philosophies for designing and setting protection system. The cost of the protection system depends on the network voltage levels: high, medium and low voltage levels. High voltage equipments are more expensive than lower voltage levels and therefore their protection system is more expensive. Nowadays, protective relays are using the digital techniques which enable to include many functions in one relay. For high and medium voltage level networks it is worthy, but for low voltage level networks it is expensive to use digital relays.

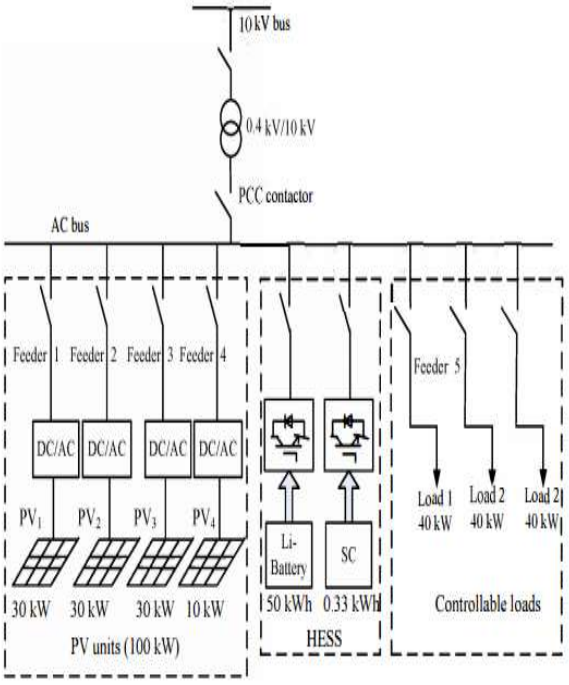

Fig.1. Flow Diagram of Proposed method.

II. METHODOLOGY

- The microgrid has shown to be a promising resolution for the integration and management of intermittent renewable energy generation. This analysis looks at important problems surrounding microgrid control and protection.
- It proposes AN integrated control and protection system with a hierarchical coordination control strategy consisting of a complete operation mode, a grid-connected operation mode, and transitions between these 2 modes for a microgrid.
- To enhance the fault ride-through capability of the system, a comprehensive three-layer hierarchical protection system is additionally planned, that fully adopts different protection schemes, like relay protection, a hybrid energy storage system (HESS); regulation, and an emergency control.
- The effectiveness, feasibleness, and practicality of the projected systems are valid on a practical photovoltaic (PV) microgrid.
- This study is predicted to produce some theoretical guidance and engineering construction experience for microgrids normally.
- Grid-connected and complete operations are the 2 typical operation modes in a very microgrid. the necessities of PV microgrid operation modes include:
  1) The microgrid voltage and frequency ought to be stable and therefore the power flow ought to be balanced, thus on notice the independent operation in numerous modes;
  2) The 2 modes will transfer smoothly from one to the opposite, which may help avoid transient surge within the microgrid.
- When the microgrid operates in complete mode, the Li-Battery energy storage system (BESS) is that the main power supply for providing stable voltage and frequency with the VIF control.
- To improve the practical application of this method, the projected VIF control.

III. RESULT

The microgrid has shown to be a promising solution for the integration and management of intermittent renewable energy generation. This analysis looks at vital problems surrounding microgrid control and protection. It proposes an integrated control and protection system with a hierarchical coordination control strategy consisting of a complete operation mode, a grid-connected operation mode, and transitions between these 2 modes for a microgrid. This approach provides an additional reliable and strong grid because the systems will supplement one another. However, protection and control during a meshed power network setup could be a challenge. This can be because a meshed microgrid has a lot of interconnections.

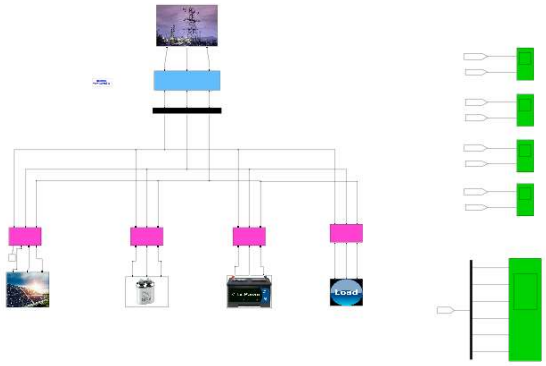

Fig.2. Proposed model.

Fig .2 shows the proposed model for control strategies and protection schemes, many tests have been undertaken on the PV microgrid. In the proposed schemes there are two operations are consists that is stand alone operation and grid connected operation.

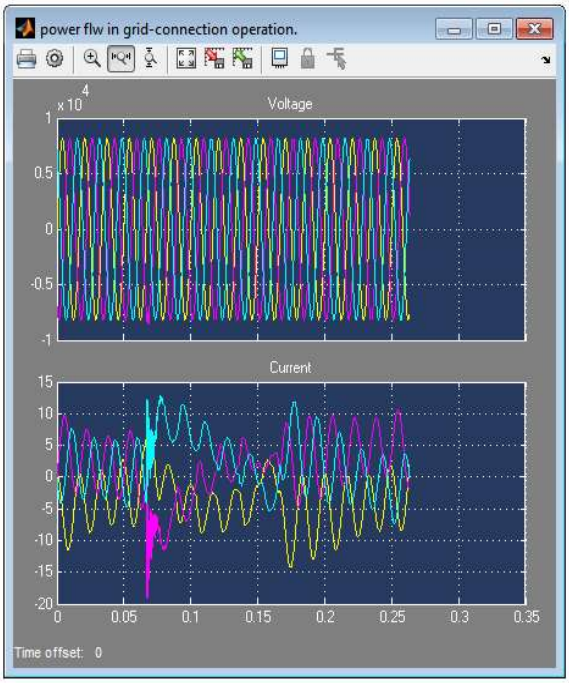

Fig.3. Power flow in grid connection operation.

The battery energy storage system is controlled as a power buffer to provide power flow with PQ control when the microgrid operates in grid connected mode. Based on the fact that the current can be obtained from power and voltage, a simplified PQ control is proposed. The quantities of current reference are obtained by utilizing the instantaneous power theory, and the current loops are used to regulate the output value with PI regulators. In addition, the PWM technique is also adopted in generating. In this

figure shows the voltage and current waveforms with respect to the time of Power flow in grid connection operation.

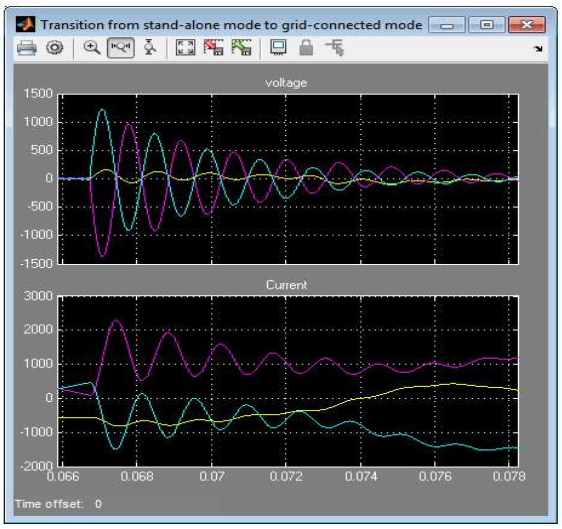

Fig.4. Transition from stand alone mode to grid connected mode.

Fig. 4 shows the Transition from stand alone mode to grid connected mode. In this figure voltage and current waveforms with respect to the time. When the microgrid operates in stand-alone mode, the Li battery energy storage system (BESS) is the main power source for providing stable voltage and frequency with the VIF control.

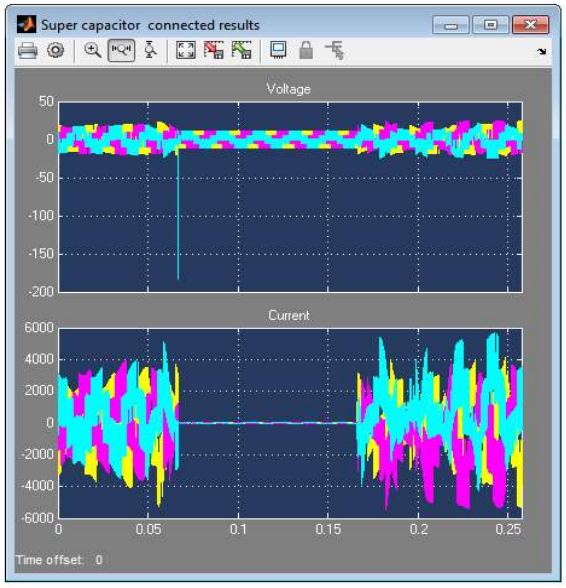

Fig.5. Super capacitor connected results.

Fig .5 shows the Super capacitor connected results. In this figure shows the voltage and current waveforms with respect to the time of super capacitor connected results.

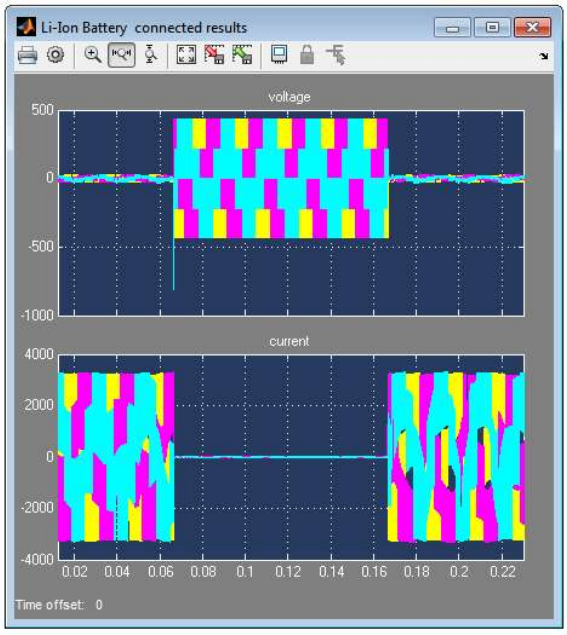

Fig.6. Li-Ion Battery connected results.

Fig.6 shows the Li-Ion Battery connected results. In this figure shows the voltage and current waveforms with respect to the time of Li-Ion Battery connected results.

Fig.7.Switching Pulses.

IV. CONCLUSION

An integrated protection and system with a hierarchical data structure is planned and a 100 kWp photovoltaic small grid is constructed to validate the effectiveness and feasibleness of the planned strategy. Simulation results show that stable and versatile transition between totally different operation modes of the PV microgrid is achieved and therefore the viability of the micro-grid below severe

fault is greatly improved. To enhance the fault ride-through capability of the system, a comprehensive three-layer hierarchical protection system is additionally planned, that fully adopts totally different protection schemes, like relay protection, a hybrid energy storage system (HESS) regulation, and an emergency control. The effectiveness, feasibleness, and usefulness of the planned systems are valid on a practical photovoltaic (PV) microgrid. It proposes an integrated control and protection system with a hierarchical coordination control strategy consisting of a complete operation mode, a grid-connected operation mode, and transitions between these 2 modes for a microgrid.

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