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Three Phase AC DC Microgrid System

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Abstract: Due to increase in deployment of different kinds of power generations and the grid has raised major concern with existing AC systems. Most of the micro grid with DGs and renewable energy sources operated in parallel with AC main grids. Since the majority of the power grids are presently ac type, ac micro grids are still dominant and purely dc micro grids are not expected to emerge exclusively in power grids. Therefore, dc micro grids are prone to be developed in ac types even though in subordinate. Consequently, linking ac micro grids with dc micro grids and employing the profits of the both micro grids, has become interesting in recent studies. The idea is to merge the ac and dc micro grids through a bidirectional ac/dc converter and establishing a hybrid ac/dc micro grid in which ac or dc type energy sources and loads can flexibly integrate into the micro grids and power can smoothly flow between the two micro grids. Like other micro grids, the hybrid ac/dc micro grid can operate either in grid-connected or in islanding modes and the control system should be able to support the two operating modes as Well as transition between these modes. Therefore, a suitable control strategy to coordinate the operation of dc sources, ac sources and the IC is indispensable.

Keywords: AC, DC, Microgrid, Power system, three phase

I. Introduction:

Rapid depletion of fuel reserves, ever increasing energy demand and considerations over global climate change has encouraged power generation from renewable energy sources. Star electrical phenomenon (PV) and diesel generator have emerged as mostly used energy sources as they are eco-friendly and price effective. However, these sources are irregular in nature. Hence, it is difficult to produce stable and continuous power using these sources. This will be self-addressed by a group of actions with energy storage components. The solar insulation and diesel generator rate pattern has semiconductor diode to make the analysis on their integration to develop the hybrid PV-diesel generator systems making them more beneficial. In order to get working of multiple renewable sources altogether, the standard approach involves using dedicated single-input converters for each of the supply, which is connected to a standard dc-bus. However, these converters are not utilised effectively as they are irregular in nature. There are multiple power conversion stages that help in developing the system. A two-way multiple input non-isolated dc-dc convertor is used to interface a capacitor and battery for transport applications. The convertor is capable of attraction from multiple energy sources to produce the desired power. However, energy delivered is not flexible. The parallel or series configuration will be used at the output to derive multi-port dc-dc converters. The circuit is simple and also the power density is improved. The coupled inductors replace two filter inductors within the bi-directional buck-boost converters and also the isolated electrical device within the full-bridge topology is integrated. Further, the pulse width modulation (PWM) and - phase-shift (PPS) management strategy is used to attain voltage regulation inside a precise in operation vary. A multi-port convertor for a hybrid system is conferred. Quick exhaustion of non-renewable energy source has yielded the demand of using the renewable resources. Photovoltaic (PV) and the diesel generators have emerged as well known sources due to their eco-accommodating nature and cost adequacy. Be that as it may, these sources are discontinuous in nature. Consequently, it is a test to supply steady and persistent power utilizing these sources. This is tended to proficiently coordinating with vitality stockpiling components. The intriguing correlative conduct of PV based insulation and deisel generator speed design combined with the previously mentioned preferences, has prompted the examination on their coordination bringing about the half and half PV-diesel generator frameworks. For accomplishing the mix of various inexhaustible sources, the approach includes utilizing committed single-input converters one for each source, which is associated with a typical dc-transport.

Microgrid:

Many trends are developing that will change the requirements of energy distribution as electric distribution technologies are advancing. These modifications are being driven from both the demand side where higher energy availability and efficiency are desired and from the supply side where the integration of distributed generation and peak-shaving technologies must be accommodated.

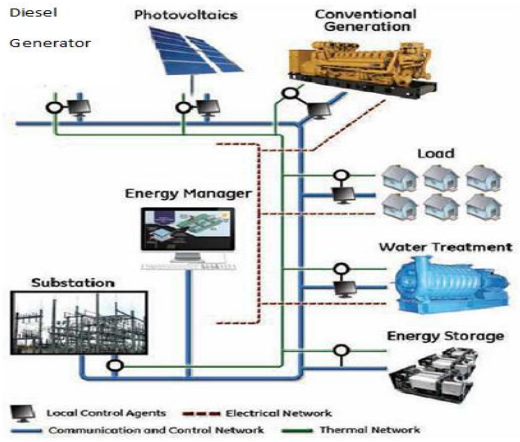

Figure 1.1: Micro-grid power system

The storing device in the micro-grid is equivalent to the rotating reserve of large generators in the conventional grid which ensures the balance between energy generation and consumption especially during rapid changes in load or generation. From the customer point of view, micro-grids deliver both thermal and electricity requirements and in addition improve local reliability, reduce emissions, improve power excellence by supportive voltage and diminishing voltage dips and possible lower costs of the energy supply. From the utility viewpoint, application of distributed energy sources can potentially reduce the demand for distribution and transmission facilities. Clearly, distributed generation located close to loads will reduce flows in transmission and distribution circuits with two important effects: loss reduction and ability to potentially substitute for network assets. In addition, the presence of generation close to demand could increase service quality seen by end customers. Micro-grids can offer network support during the time of stress by relieving congestions and aiding restoration after faults. The development of micro-grids can contribute to the reduction of emissions and the mitigation of climate changes. This is because of the accessible and developing technologies for distributed generation units are based on renewable sources and micro sources that are characterized by very low emissions.

II. Proposed Methodology:

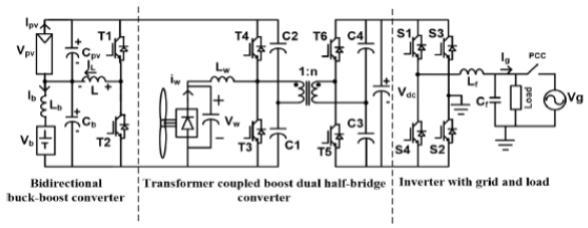

Figure 2.1 Circuit diagram of the system

This system is suitable for domestic three phase applications, where a Low-cost, simple and compact topology capable of autonomous operation is desirable. The core of the proposed system is the voltage multiplier that boosts up the voltage and makes it suitable for three phase applications. The grid-connected hybrid PV-diesel generator-battery based mostly system for house applications, which may work either in complete or grid connected mode. This method is appropriate for house applications, wherever a low-priced, straightforward and compact topology capable of autonomous operation is fascinating. The core of the planned system is that the multi-input electrical device coupled two way dc-dc device that interconnects varied power sources and therefore the storage part. The planned device consists of a electrical device coupled boost dual-half-bridge two-way device amalgamate with two-way buck-boost device and a single-phase full-bridge electrical converter. The planned device has reduced variety of power conversion stages with less part count and high potency compared to the prevailing grid connected schemes.

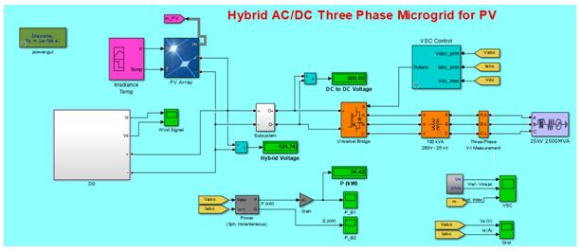

Figure 2.2: Simulink Block Diagram

A hybrid system using photo voltaic array is developed at first. The charge created by them is stored in the battery. The converter is applied for the DC to AC conversion. Boost Converter or step-up converter is a DC-to-DC power converter that steps up voltage while stepping down current from its input supply to its output load. It is a class of Switched-Mode Power Supply (SMPS) that contains at two semiconductors i.e. a diode and a transistor and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors are added to such a converter's output and input. This filtered output is given to the inverter. The inverter output is given to the Variable Source Controller(VSC) model. The VSC model is the Universal Bridge block that implements a universal three-phase power converter that consists of up to six power switches connected in a bridge configuration.

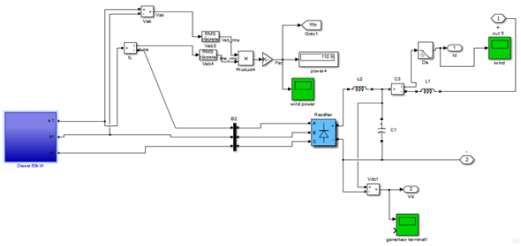

Figure 2.3:Diesel generator power generation model

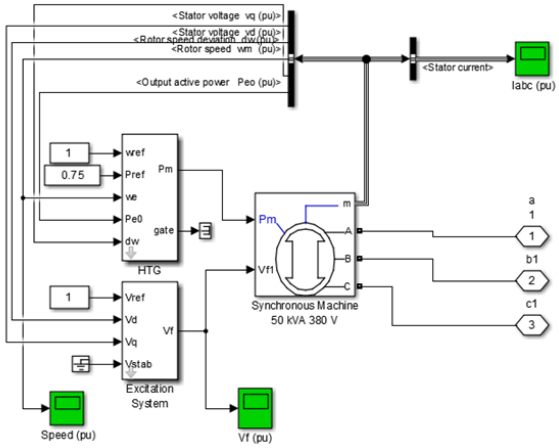

Figure 2.4: Diesel generator model

A diesel generator (also known as diesel genset) is the combination of a diesel engine with an electric generator (often an alternator) to generate electrical energy. This is a specific case of engine-generator. A diesel compression-ignition engine is usually designed to run on diesel fuel, but some types are adapted for other liquid fuels or natural gas. Diesel generating sets are used in places without connection to a power grid, or as emergency power-supply if the grid fails, as well as for more complex applications such as peak-lopping, grid support and export to the power grid. Proper sizing of diesel generators is critical to avoid low-load or a shortage of power. Sizing is complicated by the characteristics of modern electronics, specifically non-linear loads. In size ranges around 50 MW and above, an open cycle gas turbine is more efficient at full load than an array of diesel engines, and far more compact, with comparable capital costs; but for regular part-loading, even at these power levels, diesel arrays are sometimes preferred to open cycle gas turbines, due to their superior efficiencies.

III. Result:

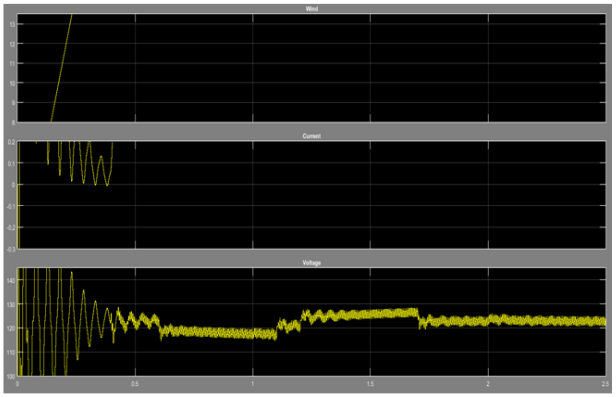

Figure 3.1: Voltage and current generated due to diesel generator energy

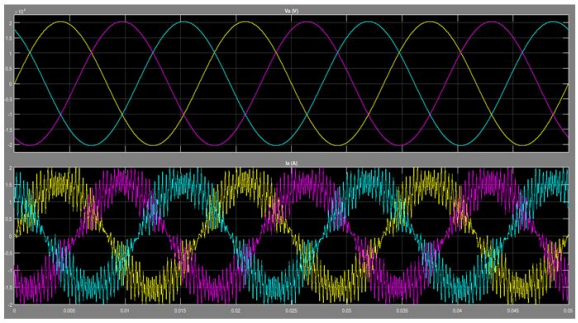

Figure 3.2: Grid voltage and current

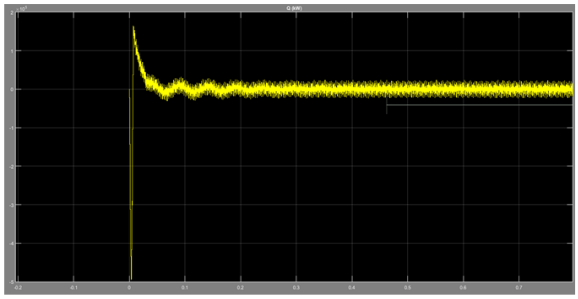

Figure 3.3: Grid power

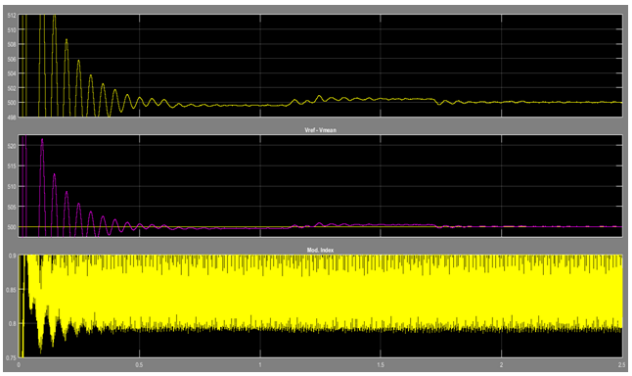

Figure 3.4: VSC output

Conclusion:

The modeling of hybrid microgrid for power system configuration is done in MATLAB/SIMULINK environment. The present work mainly includes the grid tied mode of operation of hybrid grid. The models are developed for all the converters to maintain stable system under various loads and resource conditions and also the control mechanism are studied. MPPT algorithm is used to harness maximum power from DC sources and to coordinate the power exchange between DC and AC grid. Although the hybrid grid can diminish the processes of DC/AC and AC/DC conversions in an individual AC or DC grid, there are many practical problems for the implementation of the hybrid grid based on the current AC dominated infrastructure. The efficiency of the total system depends on the diminution of conversion losses and the increase for an extra DC link. The hybrid grid can provide a reliable, high quality and more efficient power to consumer. The hybrid grid may be feasible for small isolated industrial plants with both PV systems and diesel generator generator as the major power supply.

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