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A REVIEW ON IMPROVEMENT OF POWER CONTROL METHOD IN MICRO GRID FED BY RENEWABLE ENERGY GENERATING SOURCES

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ABSTRACT

Micro grids are quickly becoming a great success for the future of electricity. The notion of the micro grid combines several micro sources without interfering with the functioning of the larger utility grid. The DC and AC networks of this hybrid Micro grid are powered by photovoltaic and wind generators. Both AC and DC Micro grids may couple with energy storage devices. A micro grid powered by a combination of renewable energy sources, such as wind and solar is shown and controlled in this project. The wind energy conversion machine is a doubly fed induction generator (DFIG), and it is coupled to a battery bank through a DC bus. Solar power is efficiently converted utilizing a DC-DC boost converter from a solar photovoltaic (PV) array and then evacuated at the common DC bus of DFIG. With the line side converter's droop characteristics implemented, voltage and frequency may be regulated using an indirect vector control. A battery's energy level is monitored, and the frequency set point is adjusted accordingly to prevent excessive charging or discharging. When wind power is not available, the system can still function. Maximum power point tracking (MPPT) is a feature of the control algorithm used by both wind and solar energy blocks. All conceivable operational scenarios have been accounted for in the system's design, making it fully autonomous. An external power supply is included into the system and may be used to charge the batteries whenever needed. The feasibility of wind and solar energy, imbalanced and nonlinear loads, and a depleted battery are only some of the scenarios simulated in this paper, along with the corresponding simulation findings.

KEYWORDS: *Battery Energy Storage (BES) System, Micro Grid, Power Quality, RenewableEnergy (RE) System, Solar PV Energy, Wind Energy*

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1. INTRODUCTION

In the previous several years, electrical energy consumption is steadily expanding day-to-day over the globe. To keep up with the rising need for electricity, many power plants have been constructed. However, the typical centralized power plant has numerous limitations like lower power, large transmission failures with a lack of fossil energy, carbonic emissions, greater cost, high formwork time, lower dependability, etc. Thus, with new issues in the electricity sectors across the world, the ideas behind centralized power generation are evolving (like generation, transmission, and distribution). As a result of the negative impacts on the environment and the scarcity of fossil fuels, conventional power generation is increasingly turning to environmentally friendly energy resources through decentralized small units. Renewable energy sources (RESs) that are close to the points of consumption are ideal for use as distributed generation (DG) units in a decentralized system. Different types of renewable energy sources, such as solar PV, wind, micro-hydro, fuel-cell, micro-turbine, etc., may see the emergence of trends in DG units that are both cost-effective and environmentally friendly. You may also hear these resources referred to as dispersed energy sources (DERs). As governments place more and more pressure on business to address environmental concerns, renewable or green alternatives to supply the grid are being increasingly common. Large-scale energy storage on a grid scale is a viable green energy option. The versatility of energy storage makes it an exciting technology. Power from renewable sources like the sun or the wind can't be stored for later use since their output is unpredictable. Because the energy produced by these random processes is not always immediately usable, energy storage technologies must be integrated in order to make the greatest use of the power produced by these sources. There are a number of ways in which energy storage might be put to use in the realm of upkeep. The current system of infrastructure is obviously outdated and in need of updating. The necessity for continuous grid energization, especially when working with sensitive loads, is one of the main obstacles to maintaining and modernizing the grid. Grid repair that does not necessitate de-energizing a specific section of the grid may be performed quickly and cheaply with the help of local energy storage devices.

II. RESEARCH OBJECTIVES

- The current MG design serves as a connection to the primary grid.
- Each DERs unit is coupled with a power conditioning interface to accomplish regulated operation, metering, and security along with the applicability of a plug 'n' play facility, not withstanding MG control schemes like islanded and grid-connected.
- The goals of taking these into account are to minimize project costs and ensure a sustainable future by increasing dependability, efficiency, robustness, reducing system losses, optimizing energy usage, and mitigating greenhouse gas emissions.

III. SYSTEM COMPONENTS DESCRIPTION

The system's 15 kW and 5 kW average power demands are tailored to meet the needs of the most power-hungry environments. Blocks of wind and solar energy with ratings of up to 15 kW can be used by REGS. Providing the hamlet with one day's worth of electricity use from each of the two source blocks with a 20% power use factor is feasible. In the case that the wind energy source has insufficient power, the circuit breaker is isolated from the rest of the system, as shown in the plan. Battery storage is connected to the high voltage (HV) side of the solar system, which in turn is connected to the DC side, where the RSC is located. RSC allows the wind power technology to continuously operate at the optimum rotational speed as determined by the W-MPPT algorithm. The system voltages together with frequency are controlled by the LSC. The kinetic energy of the wind is captured by the turbine and used to provide a driving torque for DFIG.

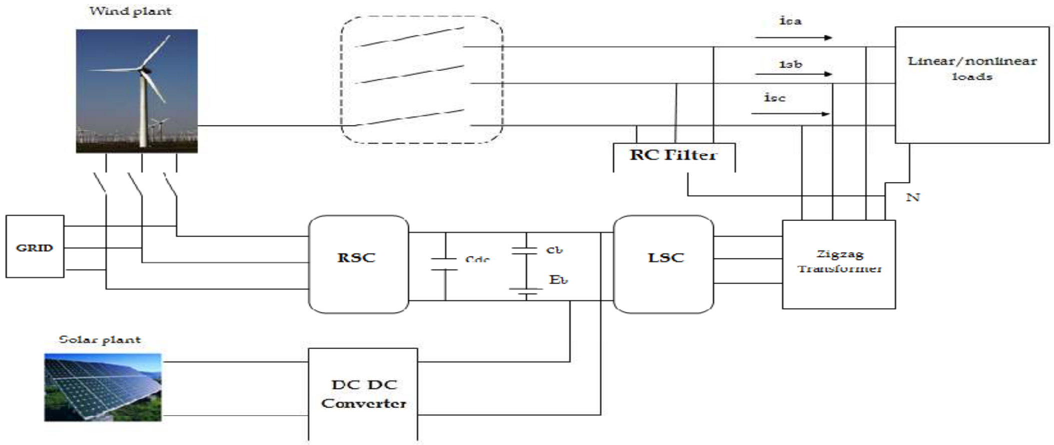

Figure 1: Schematic System Modelling of Hybrid Micro Grid.

The lower control level refers to the control systems associated to the system components, while the higher level relates to the management of the energy flows, using a mixed criterion that takes into consideration both energy cost and battery lifespan. Lower level implementation for wind energy system guarantees ideal regimes for wind farm (in terms of resource criteria), i.e. guarantees maximum power transfer in light load and power constraint in full load determines. The sun's rays are harnessed and transformed into electricity in this system. Using photovoltaic (PV) cells, solar energy may be transformed into electricity in a direct process. Enhanced output power is seen in PV energy systems at ideal loads. To reach the necessary voltage level when hooked up to the utility grid, numerous converter topologies such as boost, buck-boost converter, SEPIC, and fly back are discussed in this section. The kinetic energy of wind is converted into mechanical energy, and then into electricity by a wind turbine generator. Turbine blades are paired with a generator via a gear box in this system to harvest energy in a flexible and adaptable fashion.

The amount of electricity generated by the wind, is represented as Pwe,

$$P_{we} = \eta_g P_{wm} = \eta_g \cdot 0.5\pi\rho R^2 C_P(\lambda) v^3$$

Where, Pwm represents the mechanical power, ηg represents the electric generator efficiency, ρ represents the air density, R represents the length of the turbine blades, v represents the wind speed, and Cp represents the wind turbine coefficient, which is dependent on the tip speed ratio. The analogous circuit of a typical PV model includes the photocurrent, diode, parallel resistor (expressing leakage current), and series resistor (expressing internal resistance to current flow). A solar cell's voltage current typical equation is as follows:

$$I_{pv} = I_{PH} - I_S[\exp\,(q(V_{pv} + I_{pv}R_S)/kT_C A)\ - 1] - (V_{pv} + I_{pv}R_S)/R_P$$

Traditional methods of control used to maintain stability in MG.

IV. RESULTS AND DISCUSSION

The Simulink model of micro grid fed by REGS is developed in MATLAB. The solar panels and wind turbine are modelled using their functions. Fig. 3 shows results at unbalanced nonlinear load and Fig. 4 at loss of load. Fig. 5 shows a scenario when stored energy and generated power are low and external charging requirement through RSC is activated. Fig. 6 shows scenario when dc bus voltage is running at high charging power.

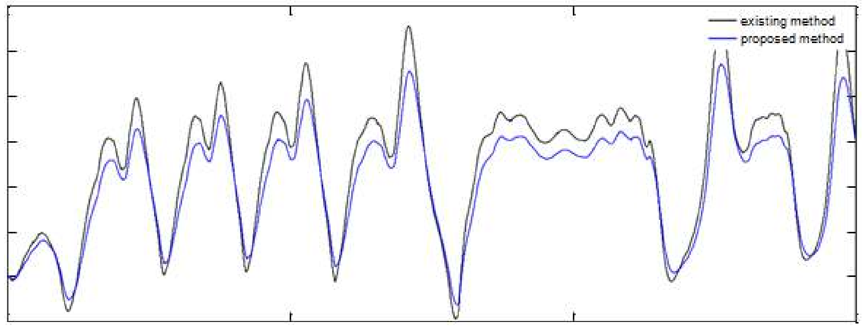

Figure 2: Comparison Waveform of Wind Energy.

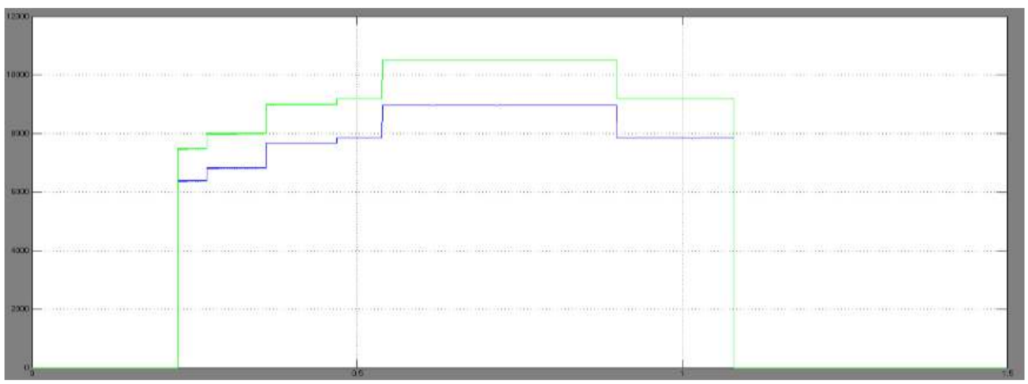

Figure 3: Comparison Waveform of Solar Energy.

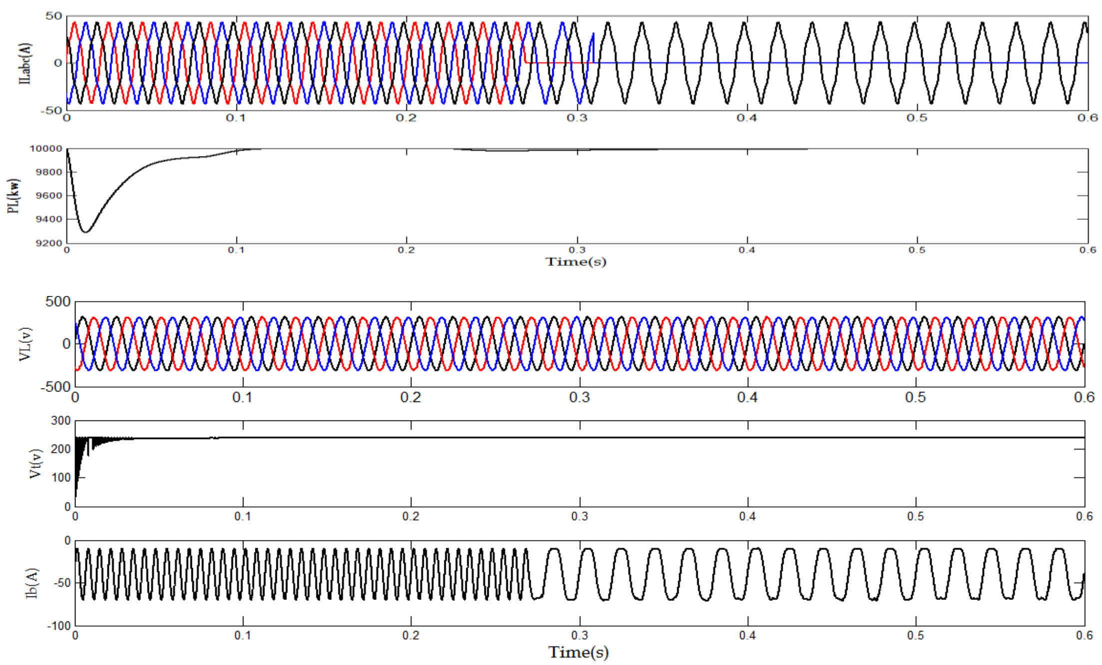

Figure 4: Proposed System for Load Changes.

CONCLUSION

The focus of the current study is on the hybrid grid's grid-tied mode of operation. All of the converters' models are built, and the stability of the system under different loads and resource situations is evaluated, along with the mechanisms of control. The maximum power point tracking (MPPT) technique is employed get the most out of Dc supplies and to regulate the flow of energy between the DC and AC grids. It has been determined that a rural area with modest residential load requirements can be serviced by the planned REGS micro grid system. REGS incorporates wind and solar resource blocks that are meant to harvest maximum electricity from wind sources and provide consumer grade electricity in parallel. It is envisioned that the gadget will be fully automated.

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