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Design of Modern Grid Fed from Hybrid (Solar and Wind) Energy Source

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ABSTRACT

This paper presents a control of a micro-grid at an isolated location fed from wind and solar based hybrid energy sources. The machine used for wind energy conversion is doubly fed induction generator (DFIG) and a battery bank is connected to a common DC bus of them. A solar photovoltaic (PV) array is used to convert solar power, which is evacuated at the common DC bus of DFIG using a DC-DC boost converter in a cost effective way.

KEYWORDS: *PV, DFIG, DER, ESS, MPPT*

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I. INRODUCTION

The main micro-grid elements embody masses, DERs, master controller, sensible switches, and protecting devices, similarly as communication, management and automation systems. Micro-grid masses are usually categorized into two types: fastened and versatile (also called adjustable or responsive). Fastened masses cannot be altered and should be glad underneath traditional operational conditions whereas versatile loads are conscious of dominant signals. Versatile masses might be curtailed (i.e., curtail able loads) or delayed (i.e. shift ready loads) in response to economic incentives or islanding necessities. DERs consists of distributed generation units (DG) and additionally with distributed energy storage systems (ESS) that might be put in at electrical utility facilities and/or electricity consumers' premises. A doubly fed induction generator (DFIG), as a generator is often used for industrial wind generation and its applications are bestowed by several authors in their publications for autonomous application in conjunction with solar PV array. DFIG could operate variable speed operation with lower power rated converters. However, to figure the system as a micro-grid, the generated voltage ought to be balanced and doctor's degree (Total Harmonics Distortion) should be inside demand of IEEE-519 normal at no-load, unbalanced load moreover as nonlinear load. Moreover, each the wind and star energies sources ought to operate at MPPT. None of the authors has reported of these problems. They need not bestowed performance parameters e.g. power quality, system potency etc. below the various in operation conditions. Moreover, they additionally lack experimental verification. The weather and climate can't be directly controlled like fossil fuelled generation. Power networks were designed to control by electricity generated during a few massive power stations that work by fuels that are promptly out there on the international market which are manageable to varied degrees. Therefore the important increase of the input from renewable energy sources needs a revision of however power systems are designed and operated so as to accommodate these sources higher. These resources are out there within the kind that either they need to be regenerate into electricity or their electrical output should be conditioned before it may be fed into the grid. The renewable energy generator could also be represented either as standalone or grid connected. During a standalone system a renewable energy generator (with or while not backup generator or storage) provides most of the demand. During a grid connected system the RE generator feeds power to an oversized interconnected grid, which is additionally fed by a spread of alternative generators. The small grid, i.e. outlined by the U.S. Department of Energy, could be a cluster of interconnected masses and distributed energy resources (DER) together with clearly outlined electrical boundaries that acts as one governable entity with reference to the grid which will connect and disconnect from the grid and to alter it to control in each grid-connected or island modes. supported this definition, DER installations may be thought of as a small grid if comprised of three

distinct characteristics: they have electrical boundaries that are clearly outlined, additionally there should exist a master controller to manage and operate DERs and masses as one governable entity, and therefore the output in generation capability should exceed the high vital load therefore it may even be disconnected from the utility grid, i.e., the islanded mode, and seamlessly offer native vital masses. These characteristics more gift micro-grids as small-scale power systems with the flexibility of self-supply and islanding that may generate, distribute, and regulate the flow of electricity to native customers. Micro-grids are over simply backup generation. Backup generation units have existed for quite a while to supply a brief supply of electricity to native masses once the provision of electricity from the utility grid is interrupted. Micro-grids, however, offer a wider variety of advantages and are considerably a lot of versatile than backup generation.

II. PROBLEM DEFINITION

The Wind and solar energies suffer from high level of power variability, low capacity utilization factor combined with unpredictable nature. As a result of these factors, firm power cannot be guaranteed for autonomous system. While the battery energy storage (BES) can be helpful of lowering power fluctuation and increasing predictability, utilisation factor can be increased by operating each energy source at optimum operating point. The optimum operating point also called as maximum power point tracking (MPPT), requires regulation of the operating point of wind energy generator and solar PV (Photovoltaic) array in term of speed and voltage to extract maximum electrical energy from input resource. The proposed system is a micro grid based on wind and solar renewable energy generating sources.

III. METHODOLOGY

This work can adopt a research methodology that mixes the idea model with empirical analysis and refinement of the planned theme on MATLAB simulation tool. MATLAB is a useful high-level development environment for systems which require mathematical modeling, numerical computations, data analysis, and optimization methods. The same has been designed for location having maximum power demand and average power demand of 15 kW and 5 kW, respectively. The rated capacity of both wind and solar energy block in REGS is taken as 15 kW. The capacity utilization factor of 20% is considered for both energy blocks, which is enough to provide full day energy requirement of the hamlet. As shown in a schematic diagram, the wind energy source is isolated using a 3-pole breaker from the network in case of insufficient wind speed. The DC side of both Rotor Side Converter (RSC) and Line Side Converter (LSC) along with HV side of solar converter is connected at the battery bank. RSC helps the wind energy system to run at the optimum rotation speed as required by W-MPPT algorithm. The LSC controls the network voltage and frequency.

IV. RESULTS

The results obtained using MATLAB simulation tool are as under:

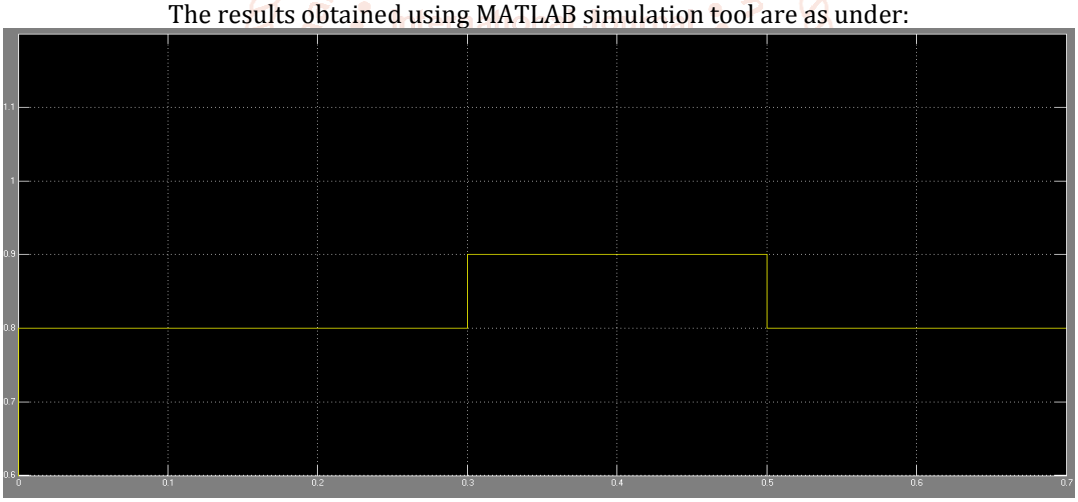

Fig.1: G-Pv

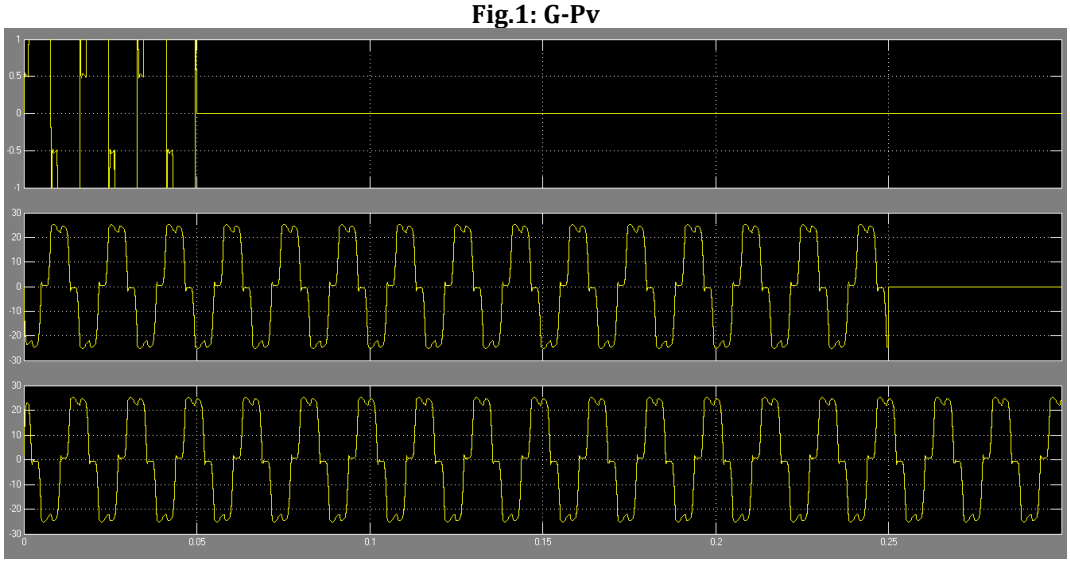

Fig.2: ILA, ILB, ILC

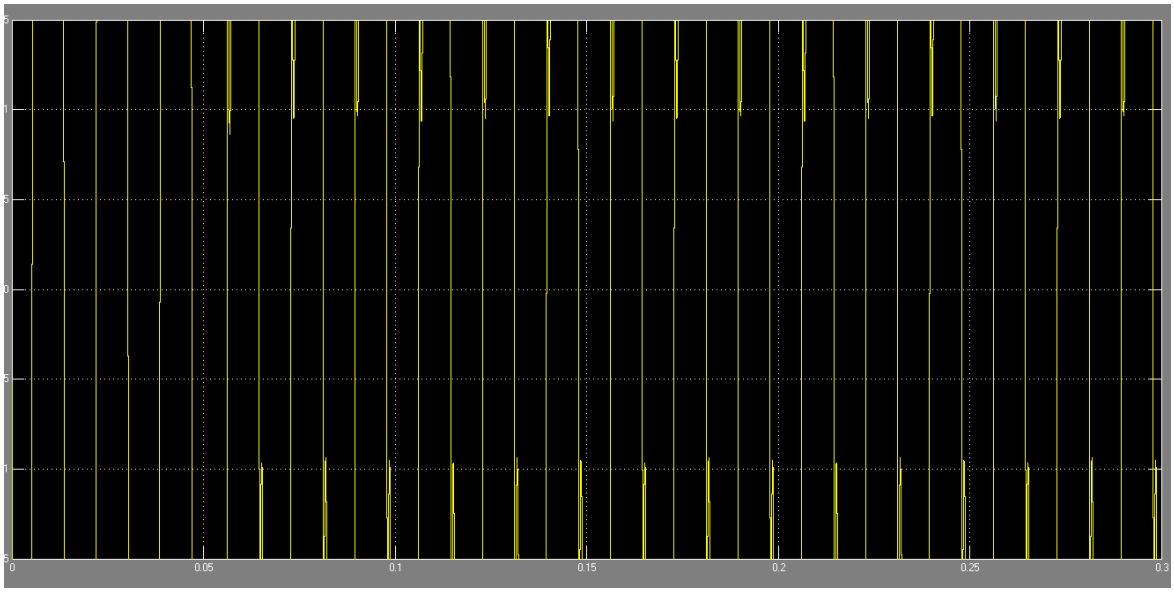

Fig.3: ILN-VL2

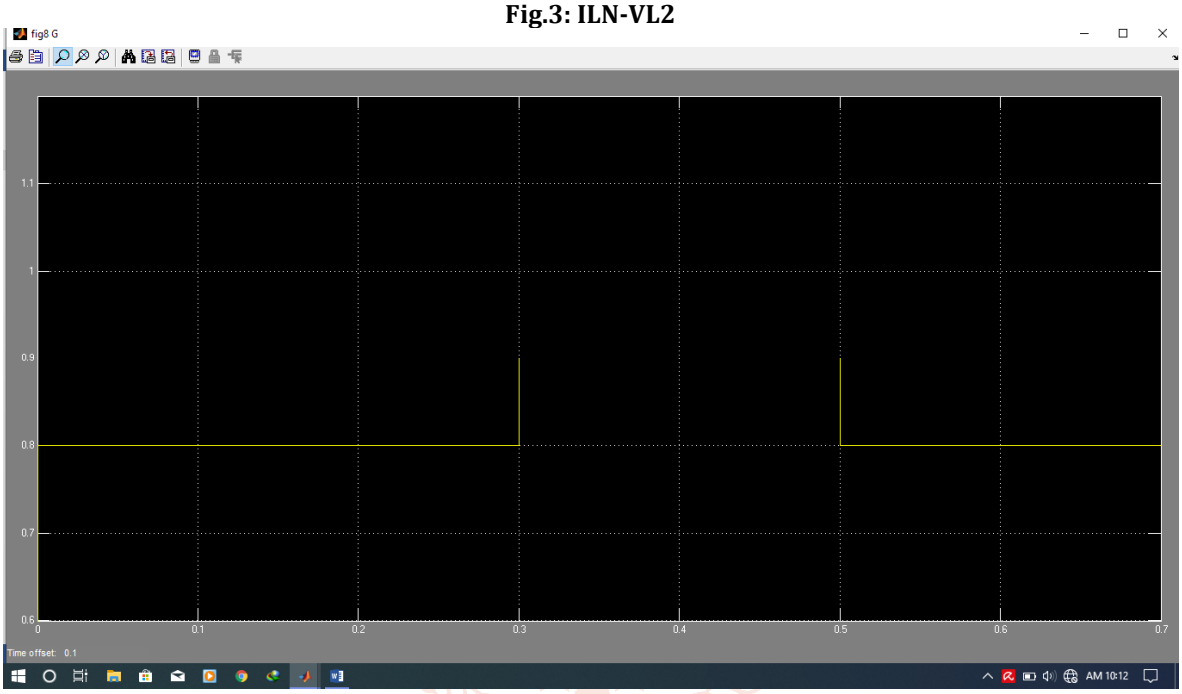

Fig.4: IS

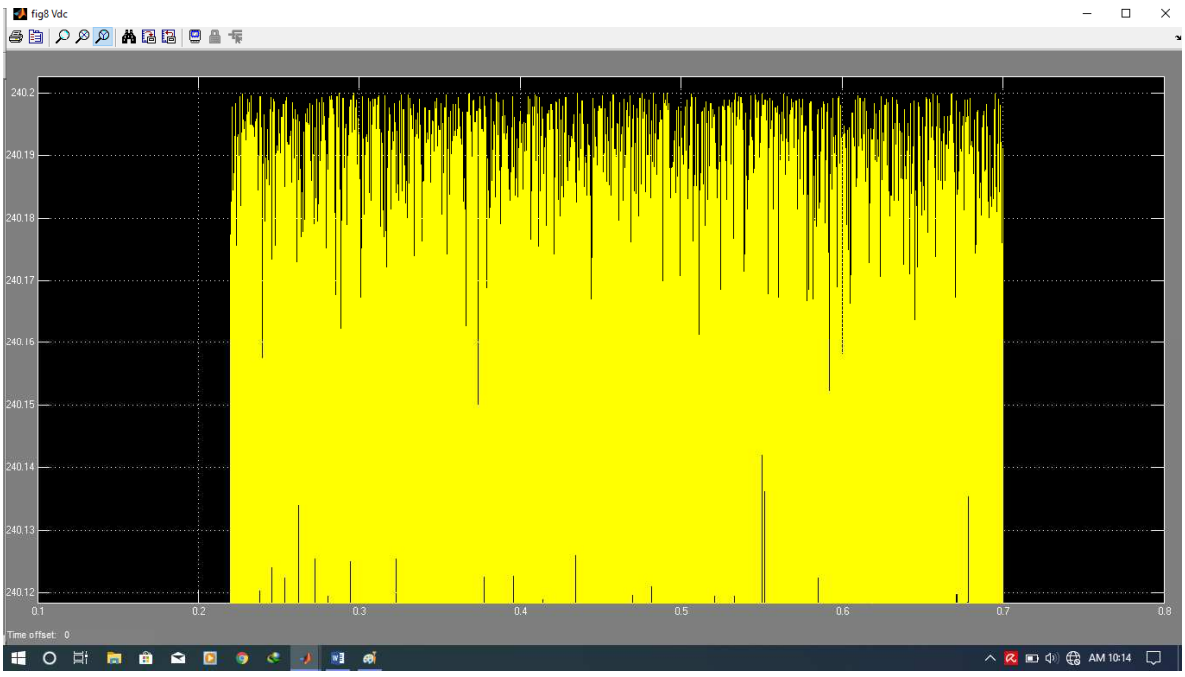

Fig.5: VDC-F

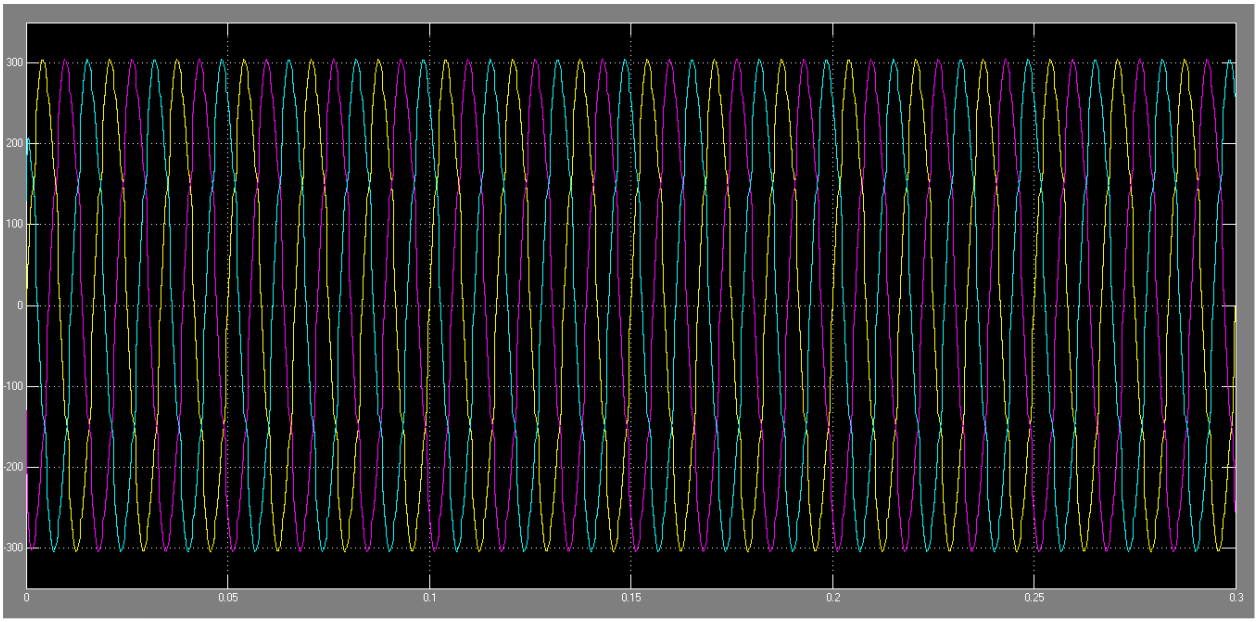

Fig.6: VL

V. CONCLUSION

The research paper presents a hybrid micro-grid system fed from REGS has been found suitable for meeting load requirement of remote isolated locations. REGS comprises of wind and solar energy blocks, which are designed to extract the maximum power from the renewable energy sources and at the same time, it provides quality power to the consumers.

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