THE NEED OF MICROGRID BASED ON DUEL RENEWABLE ENERGY

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Abstract

There are number of places across the world without electricity accessibility and there are also number of power grid connected areas which receive electricity for few hours a day. Most of the places are rich in renewable energy sources like wind, solar and bio-mass but still facing the electricity shortage. As we know that there are number of power generating sources like solar energy, water and wind but cannot fulfil the desired demands of the people and the solution for this is deployment of the hybrid micro-grid. The paper presents review on hybrid micro-grid based on renewable energy generating sources like wind and solar.

Keywords- *DFIG, BES, MPPT, REGS, LSC, PV.*

I.INTRODUCTION

The U.S Department of Energy defined the micro-grid a group of interrelated distributed energy sources and loads with properly clear electrical boundaries that proceeds a single convenient entity with respect to the grid and can connect and disconnect from the grid to facilitate it to work in both grid connected or island modes. Based on this definition the distributed energy resource installations possibly will be considered as micro-grid based on three characteristics: clearly defined electrical boundaries, master controller to manage and operate distributed energy resources and load as a single controllable entity and the generation capacity installed must go above the peak critical load. These above mentioned characteristics further present micro-grids as a small scale power systems with the talent of self supply and islanding which could generate, distribute, and regulate the flow of electricity to local customers. The significance of the deployment of hybrid renewable energy based micro grid is a promising aspect in the future of power systems. With this intention the micro grid architecture is designed consisting of high penetration of distributed generators linked to the grid through controllable power electronic based devices, along with the inclusion of communication techniques, electrical energy storage systems [1]. DFIG machine is deployed for wind energy conversion which is a doubly fed induction generator. 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 and the voltage and frequency are controlled through an indirect vector control of the line side converter, which is incorporated with droop characteristics [2]. The review on grid integration and power quality issues associated with the integration of renewable energy systems into grid and role of power electronic devices and flexible

AC Transmission Systems related to these issues are clearly explained [3]. The microgrid is characterized by the integration of distributed energy resources and controllable loads in a power distribution network. Such integration introduces new unique challenges to microgrid management that have never been exposed to traditional power systems [5]. An isolated microgrid consisting of sources like wind, solar, biogas with battery. Provision of utility grid insertion is also needed if total microgrid sources falls short of supplying the total load. To establish an efficient energy management strategy, a central controller takes the decision based on the status of the loads and sources [7]. There is great advantages of micro-grids in future power systems and energy sources like hydro and wind offers the best capacity for emission free power for future micro-grid systems [8].

II.LITERATURE REVIEW

Velmurugan et al (2018) the research paper entitled "Hybrid Renewable Energy Based Micro Grid" describes the effect of fossil fuels on the global warming. The paper defines the importance of micro-grid and is a concept that integrates the DER (Distributed Energy Resources) to develop an independent electric infrastructure. This paper presents the significance of the deployment of hybrid renewable energy based micro grid as a promising aspect in the future of power systems. With this intention the micro grid architecture is designed consisting of high penetration of distributed generators linked to the grid through controllable power electronic based devices, along with the inclusion of communication techniques, electrical energy storage systems.

Tiwari and Goel (2017) the research paper entitled "Design and control of Micro-Grid fed by Renewable Energy Generating Sources" describe the control of a micro-grid at an isolated location fed from wind and solar based hybrid energy sources. DFIG machine is deployed for wind energy conversion which is a doubly fed induction generator. 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 and the voltage and frequency are controlled through an indirect vector control of the line side converter, which is incorporated with droop characteristics. The system also works at the absence of wind power source. The system is a hybrid concept based on solar and wind and is designed for complete automatic operation taking consideration of all the practical conditions.

Kumar et al (2016) the research paper entitled "Grid Integration and Power Quality Issues of Wind and Solar Energy System: A Review" presents review on grid integration and power quality issues associated with the integration of renewable energy systems in to grid and role of power electronic devices and flexible AC Transmission Systems related to these Issues. In this paper, recent trends in power electronics for the integration of wind and photovoltaic (PV) power generators are presented.

Kumar and Tiwari (2016) the research paper entitled "Renewable Energy Resources with Smart Microgrid Model in India" describes energy crisis facing people of India with the increase of energy consumption. Even for electricity generation from renewable sources.

Renewable energy such as sunlight, wind, rain, tides, and geothermal heat will have to depend on natural resources. This paper describes dynamic demand response and smart micro-grid for residential and industrial consumption in the context of renewable energy production, including the proposed management approach. The objectives of this research, renewable energy resources with a smart micro-grid have played an important role.

Lee et al (2016) the research paper entitled "Design and Implementation of a Microgrid Energy Management System" describes microgrid and is characterized by the integration of distributed energy resources and controllable loads in a power distribution network. Such integration introduces new, unique challenges to microgrid management that have never been exposed to traditional power systems. To accommodate these challenges, it is necessary to redesign a conventional Energy Management System (EMS) so that it can cope with intrinsic characteristics of microgrids.

Kumar and Bhimasingu (2015) the research paper entitled "Renewable energy based microgrid system sizing and energy management for green buildings" presents the hybrid power system model for building with economically optimal. The system is modelled and the optimal system configuration is estimated with the help of hybrid optimization model for electric renewable (HOMER). The logic is illustrated with a case study based on the practical data of a building located in southern India.

Zaheeruddin and Manas (2015) the research paper entitled "Renewable energy management through microgrid central controller design: An approach to integrate solar, wind and biomass with battery" describes an isolated microgrid consisting of sources like wind, solar, biogas with battery. Provision of utility grid insertion is also given if total microgrid sources falls short of supplying the total load. To establish an efficient energy management strategy, a central controller takes the decision based on the status of the loads and sources. The status is obtained with the assistance of multi-agent concept (treating each source and load as an agent).

Ravichandrudu et al (2013) the research paper entitled "Design of Micro-grid System Based on Renewable Power Generation Units" describes the importance of micro-grid based systems in future power systems. Renewable power sources such as wind and hydro offer the best potential for emission free power for future micro-grid systems. This paper presents a micro-grid system based on wind and hydro power sources and addresses issues related to operation, control, and stability of the system.

Che and Chen (2012) the research paper entitled "Research on Design and Control of Microgrid System" describes the popularity of micro-grid across the globe in recent years. The optimal configuration issue of micro-grid system is described briefly first. And then the monitoring system of micro-grid system is discussed in details. Different control methods of micro-grid system and their advantages and shortcomings are analyzed later. The comparative analysis of different control methods is carried out. Finally, a laboratory-scale micro-grid system is proposed as

an example to verify the micro-grid control strategy.

Zhao et al (2011) the research paper entitled "Design and Implementation of an Integrated Micro-Grid System" describes the Micro-grid in detail with its impacts on large power grid of distributed applications. In this paper, an integrated micro-grid system with flexible structure and reliable multi-micro-grids system structure is proposed which contains a variety of distributed generations and energy storage systems. The small micro-grids can operate separately or in the form of one large micro-grid. And this system, using master-slave control strategy, can switch flexibly between grid-connected operation mode and independent operation mode.

Song et al (2011) the research paper entitled "Research on Control of Micro Grid" describes the micro-grid for future power systems. This paper proposes a hybrid control method for the whole micro grid and a systematic control method design of micro-sources in grid-connected mode and isolated mode are analyzed.

III. EXISTING SYSTEM

Wind and solar energy sources, are more favourite than bio-mass based system as latter is susceptible to supply chain issue. However, 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.

IV. DRAWBACKS OF EXISTING METHOD

DFIG may operate variable speed operation with lower power rated converters. However, to work the system as a micro-grid, the generated voltage should be balanced and THD (Total Harmonics Distortion) must be within requirement of IEEE-519 standard at no-load, unbalanced load as well as nonlinear load. Moreover, both the wind and solar energies sources should operate at MPPT. None of the authors has reported all these issues. They have not presented performance parameters e.g. power quality, system efficiency etc under the different operating conditions. Moreover, they also lack experimental verification.

V. PROPOSED SYSTEM

This paper presents a micro-grid fed from wind and solar based renewable energy generating sources (REGS). DFIG is used for wind power conversion while crystalline solar photovoltaic (PV) panels are used to convert solar energy. The control of overall scheme helps to provide quality power to its consumers for all conditions e.g. no-load, nonlinear load and unbalanced loads. The controls of both generating sources are equipped with MPPT. In the presented scheme, the droop characteristic is embedded in control of load side converter (LSC) of DFIG. This function varies the system frequency based on state of charge of the battery and slows down deep discharge and over-charge of the battery.

VI. ADVANTAGES OF PROPOSED METHOD

DFIG is used for wind power conversion while crystalline solar photovoltaic (PV) panels are used to convert solar energy. The control of overall scheme helps to provide quality power to its consumers for all conditions e.g. no-load, nonlinear load and unbalanced loads. The controls of both generating sources are equipped with MPPT. Emmanouil *et al.* have proposed a droop based control system for micro-grid with the help of standalone battery converter.

VII. COMPARATIVE ANALYSIS OF LITERATURE REVIEW

Reference	Title	Technique	Research Findings
Velmurugan et al	Hybrid Renewable Energy Based Micro Grid	DER	Presents the importance of micro-grid and is a concept that integrates the DER (Distributed Energy Resources) to develop an independent electric infrastructure
Tiwari and Goel	Design and control of Micro-Grid fed by Renewable Energy Generating Sources	DFIG	Presents the control of a micro-grid at an isolated location fed from wind and solar based hybrid energy sources
Kumar et al	Grid Integration and Power Quality Issues of Wind and Solar Energy System: A Review	Power Electronics	Presents review on grid integration and power quality issues associated with the integration of renewable energy systems
Kumar and Tiwari	Renewable Energy Resources with Smart Microgrid Model in India	Smart Micro-Grid	Describes energy crisis facing people of India with the increase of energy consumption
Zaheeruddin and Manas	Renewable energy management	central controller	Presents an isolated microgrid consisting

	through microgrid central controller design: An approach to integrate solar, wind and biomass with battery		of sources like wind, solar, biogas with battery

VIII. RESULTS

The comparative results of Duel Renewable Energy based Grid literature is given below:

Open Circuit Voltage of PV cell, Vocc	0.64 V
Open circuit voltage of a module (Voc)	23.04 V
MPP voltage of PV cell, Vmpc	0.5223 V
MPP Voltage of module(Vmp)	18.83 V
Short Circuit current of module(Isc)	8.69 A
MPP current of module (Imp)	8.04 A
Module Power Rating	151 Wp
μIsc	0.04 %/ oC
μVoc	-0.36%/ oC
PV Modules in the solar block	11 strings each having 9 PV modules.
String open circuit voltage, usoc	207.36 V
Capacity of Solar PV System	15 kWp

TABLE 1: TECHNICAL DETAILS OF SOLAR BLOCK

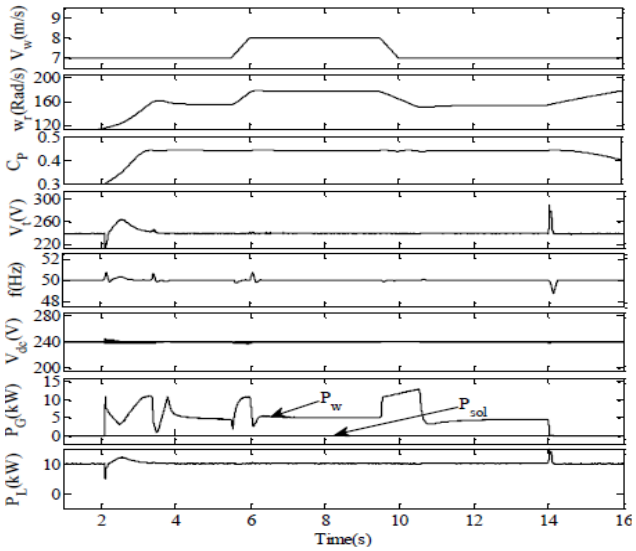

Figure 1: Performance of REGS fed micro-grid with wind energy source

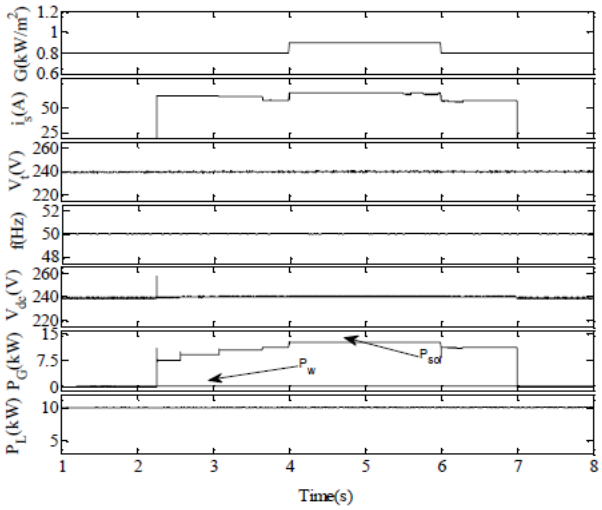

Figure 2: Performance of the system without generating source and solar system is taken in the service.

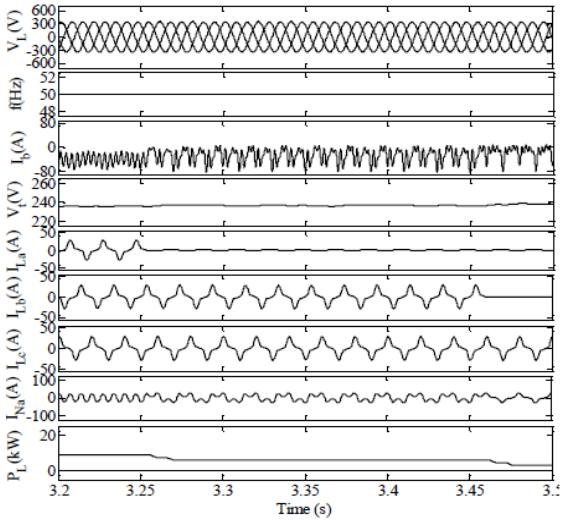

Figure 3: Performance of the system at unbalanced and nonlinear load

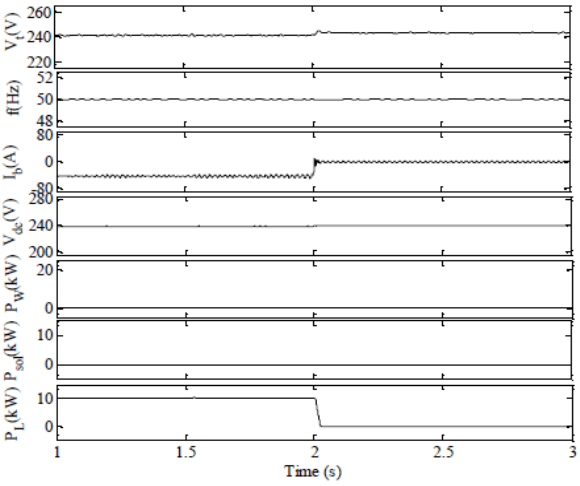

Figure 4: Performance of the system under loss of load at battery power

IX. CONCLUSION

The paper presents the micro-grid concept and its importance in future power systems. There are number of power generating sources like water, wind, solar etc. that are used by the power generating agencies but still we are facing electricity shortage. The paper presents a micro-grid based on hybrid wind and solar renewable energy generating sources.

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