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DESIGNING AND SIMULATION OF MULTI RENEWABLE SOURCES WITH ENERGY MANAGEMENT FOR HIGH EFFICIENCY THROUGHOUT THE MICROGRID

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ABSTRACT:

The problems with the design of hybrid micro-grids are system price and service quality. In this paper, we solve these problems by utilizing renewable resources optimally, maintaining State of Charge (SOC) in batteries. The proposed system also defines the lowest rate for power exchanged between the AC/DC micro-grids. Photovoltaic and wind energy are utilized as key resources in the system. Also, storage banks are coupled to both micro-grids and the fuel cell is the hold-up resource to maximize the consistency of the generation system. Supervisory controller ensures the maximum utilization of resources and by maintaining SOC to manage the exchange of power between micro-grids. This research focuses on power management in AC/DC micro-grid, and its optimization has been investigated by Multi-Objective Particle Swarm Optimization (MOPSO) algorithm. The result shows that MOPSO yields positive performance and the proposed system is recommended as the best substitute to improve electric energy utilization in remote areas.

Keywords: BESS, Circuit breaker, switch off time period, ESS.

1. INTRODUCTION:

The increasing rate of population explosion predicts an extra of 2 billion

populations by 2040. This up surge of the population is found mainly in the regions of Africa, India, and several developing countries. This has a huge consequence on the requirement on energy demand. Energy demand is predicted to surge by 30% in 2040. Developing countries have witnessed the rapid demand of energy by the population. The predictable energy, like oil and usual gas, hydroelectricity, coal and nuclear energy are not adequate to meet the need. Furthermore, the population is increasing turning to alternative energy sources. Renewable energy sources and the technology to harvest it have grown rapidly. Driven by the economic development and associated increasing demand for energy, countries are looking for ways to utilize the natural resources available to meet the demands. Our study is focused on the generation of Photovoltaic (PV) energy in India, as the main energy source [1]. Complementary nature of wind and PV resources availability are clearly specified for the year 2016 [1]. It shows there is urgent need to increase energy asset to advance the extensive scale of renewable based plants. Consequently, PV/Wind integration is proposed in this research work. Traditional power system needs more flexibility, altering the regulatory and financial situation. Energy reserves and eco- logical collision are giving impulsion for the growth of micro-grids, which are forecasted to play an important part in up- coming power schemes. The micro-grid is a unique procedure of grid which is incorporated with a mixture of dispersed production and power-electronics. It is our belief that the use of micro-grids with improved performance could provide the much needs demand of the energy requirements for the Indian populations. The paper is organized as follows: The next section briefly

review relevant literature followed by the detailed presentation of proposed methodology in the Section 3. In the Section 4 we describe the optimization process using MOPSO for HMG. Section 5 portrays the experiment evaluations carried out to validate the proposed approach along with detailed discussions on the obtained results. The paper concludes with suggestions for further research.

1.2. OVER VIEW:

Micro-grid technology is adopted to organize the different electricity sources to provide enhanced power supply solutions to the smart-grid based projects in India. Guerrero et al. [2] proposed advanced control technique architectures for hybrid micro-grids which include dispersed, scattered and categorized control scheme of grid-connected mode and islanded mode micro-grids. The problems in droop-based control techniques are eliminated in their research. The other supplementary controller is established in the micro-grid central control which restores the frequency as well as magnitude in the micro-grid. Sungwoo and Alexis [3] presented a dynamic designing and control stratagem for a micro-grid mainly for power generated by wind turbine energy and solar energy. A current-fed multi-input source DC–DC type converter is utilized to combine these renewable based energy sources to the key DC bus system [3] . Kantamneni et al. [4] have made an in-depth survey on the utilization of multi-agent systems for the control of microgrids. They have presented and discussed the context of multi-agent systems design architectures as step-by-step frameworks for the micro-grids. In 2015, Derksen et al. [5] have introduced a novel energy agent for future hybrid energy systems for systematic development. They presented a design pattern to enable

the energy agents for the large-scale simulations in the test beds and onsite real-world devices. In the same year, Dibangoye et al. [6] have explored the unit commitment and economic dispatch problem by determining the required power to be generated and the optimal schedules as a response to power demand. They also proposed a novel distributed approach to address the unit commitment problems considering the uncertainty of privacy-preserving constraints and demand and supply.

2. RELATED STUDY:

They framed the problem as bi-objective including flow time and make span for optimization. Later they presented two variants of improved proved the efficiency and performances of GAs in the scheduling problem of computational grids. Madiouni et al. [8] developed a novel method named canonical RST structure for 2DOF, and they also e implemented it successfully based on MOPSO approach. They conducted different tests over benchmark functions to validate the presented MOPSO based algorithm. With the obtained results from the conducted experiments, they have proved the superior capability of MOPSO approach through its Pareto dominance. El Dor et al. [9] presented the dynamic topology called DC luster through combining the Four-cluster and Fitness to avoid the premature convergence in the traditional PSO algorithm. Their test experiments showed that DC luster has the best perfor- mance over the other tested traditional topologies for all the tested problems and premature convergence in PSO has very less probabilities. Similarly, Shenfield and Fleming [10] developed a multi-objective evolutionary design of robust controllers for the grid and evaluated it through a computer simulation process. Eghtedarpour and

Farjah [11] presented a two-step altered droop control method for the bi-directional power flow of the hybrid type AC/DC micro-grid. By computing the AC source micro-grid operating frequency (f) and the DC source micro- grid operating voltage (V dc), the electric power management approaches can produce the power reference. The established power preserve can support both micro-grids regularly, and it also permits minimum preserve power to each micro-grid. In India, smart grid technologies are increasing consistently with many on-going projects utilizing new smart technology ranging from kW to MW covering all type of consumers. The works mentioned above have their significant focus on the DC or AC micro-grid. Technically, the hybrid AC/DC micro- grid concept is new, and it couples AC sources with AC loads and DC sources with DC loads [14] . It is to be noted that the uncertainties in the output power of the resources make changes in the generated power to be higher than or lower than the actual power demand. Such uncertainty in the generated output power leads to problem of fluctuations in the level of DC bus voltage and hence the DC bus voltage variations should be considered to be an alarming factor for power imbalance [15]. This crucial problem can be addressed by using a controller to control the DC bus voltage in the power generation system. The proposed approach is designed to be robust enough against the issues of generation prediction error and the uncertainties in the resources output power. Although restricting the power exchange between the micro-grids can improve the power quality, it cannot lead to the maximum utilization of available wind or solar power. Therefore, the trade-off between the power quality and efficiency of the power generation system is proposed

in this paper. The proposed trade-off determines the minimum value for the amount of power that should be exchanged between the micro-grids.

3. PROPOSED SYSTEM:

Major benefits of the hybrid system AC/DC source micro-grid are: (1) The abolition of preventable multiple alteration procedures, which results n transmission loss minimization and (2) the removal of entrenched rectifiers for DC heaps in the existing AC source grids, which results in easy apparatus and cost decline in power electronic converters. Despite the benefits of above-discussed points, for the hybrid micro-grid to work effectively, a superintendent control technique is required to achieve the power demand and fragmented amongst various energy resources. Also, a fuzzy logic based control scheme is needed to regulate the charge and discharge currents in the battery. The Hybrid Micro-Grid (HMG) structure, control and power management strategy is discussed in the following sections.

A renewable based hybrid model AC/DC micro-grid and its energy management is proposed in this paper. It is a novel idea, which disengages DC resources through DC heaps and AC resources with AC heaps, whereas generated power is swapped amongst both AC and DC edges utilizing a bidirectional mode converter. Depending upon the power exchange requirement, an AC–DC or DC–AC conversion is used. Photovoltaic array and wind turbine generator are utilized as key re- sources in this power production system. Also, storage banks are coupled to both AC and DC source micro-grids, and the fuel cell is considered as a hold-up resource to maximize the consistency of the generation system. When the power delivery from the input DC sources is larger compared to the DC demand, the inverter operates and

inserts power from DC to AC source sub-grid system and also to utility grid system. When the entire power production is smaller than the total heap demand at the DC source side, the inverter performs as a converter and inserts power from the AC sub-grid system and utility grid system to DC side. At the same time, DC source bus voltage stabilization is controlled by PI controller. Micro-grids are a collection of DC and AC heaps, dispersed renewable energy resources and stowage devices as a battery. The growth of a hybrid micro-grid will diminish the method of numerous reverse conversions related with individual AC grid and DC grid. For the proper function of the micro-grid technique, a power management system is necessary to control electric power stream in the micro-grid scheme. It is imperative that the electric power stream points the identification of the power output of the production services to attain the power hassle in the load side. It should be noted that, considering all limitations on power switch-over between the AC and DC micro-grid schemes can develop electric power quality issues and it cannot direct to highest consumption of existing wind power or solar power. So that, a transaction among electric power system quality and total efficacy of the generation schemes is presented in this research. The presented wind generation system contains a wind-mill, permanent magnet synchronous generator (PMSG), a diode rectifier for AC–DC conversion, and a DC–DC boost converter. Block diagram in Fig. 1 shows that the power produced by wind system is regulated by an ardent DC–DC boost converter. The photovoltaic system is linked via a DC–DC boost converter mode to the DC bus. In order to compute the state of charge of the storage banks in both AC and DC micro-grids, current

addition method (coulomb counting), is employed.

4. SIMULATION RESULTS:

The Power Management System (PMS) contains a dominant processing unit with the data obtained for the entire micro- grid modules, which helps to find effective approaches aimed at power transfer among renewable resources. The smallest and extreme charge/discharge mode energy of the storage tank, and lowest permissible power interchange among the AC source and the DC source micro-grids, ought to be informed based on real-time measurements. Likewise, output instructions of the PMS are reference-points for production units, charge/discharge source power of the storage tank, and the quantity of power source must be switched within the micro-grids. The delivery instructions are directed to the controllers to enforce the micro-grid system modules to follow the attained reference-points. The power flow between AC and DC grids using bi-directional converter is shown in Fig. when wind energy alone is considered. The power flow between AC and DC grids using bi-directional converter is provided in Fig. when wind energy alone is considered. Implementation of the above approach produces huge benefits. These include:

(i) maximum usage of renewable resources fulfilling the AC load demand and DC load demand in micro-grid system,

(ii) SOC of battery is sustained together in micro- grids and

(iii) Power transfer among the AC source and the DC source micro-grids is supervised.

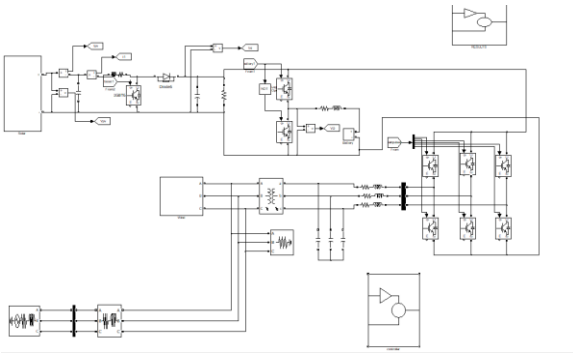

Fig.4.1.Simulation circuit.

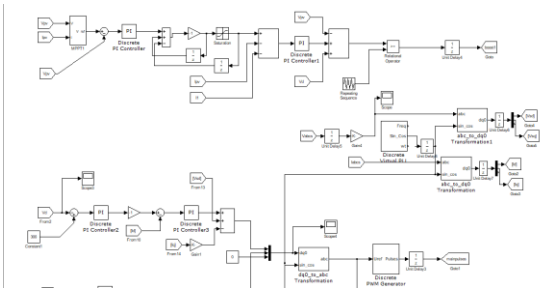

Fig.4.2.Controller circuit.

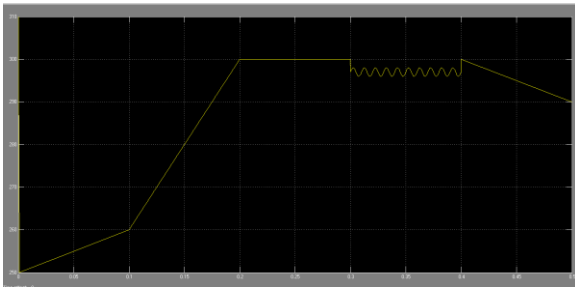

Fig.4.3. Voltage across the PV system.

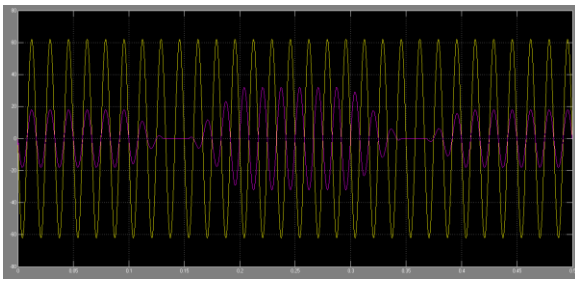

Fig.4.4. Output power.

5. CONCLUSION:

In the rural electrification, the micro-grid implementation is considered to be a most promising solution which increases the supply quality by reducing the implementation costs. A control scheme for an HMG Structure to sustain uninterrupted power supply to the consumer demand in fifteen modes of operation is presented in this research. The combination of PV, Fuel cell, wind and battery storage with adjustable parameters is analyzed. By utilizing the state machine approach, the supervisory controller sets the reference values to the generation subsystems through following a pre-defined scheme. The fuzzy controller determines the charge and discharge of battery banks by considering the difference between the generated and demanded power, and SOC. To achieve best configuration the system and better sizing of components, we have

applied MOPSO methodology by defining the objective functions for energy cost and power loss probability. The simulation results depict the price increase of electricity which leads to the substantial growth in utilization of HMG based on renewable resources. Hence using renewable resources is a worthy substitute to develop the energy power in isolated areas in India. The presented methodology can be extended to develop a modernized electrical grid utilizing advanced information and communication technologies (ICT). The incorporation of ICT to analyze the behavior of consumers and suppliers through automation with artificial intelligence may lead to the tremendous benefits of an efficient, reliable, and sustainable production and distribution of electricity.

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