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Optimization Techniques Used To Calculate Economic Load Dispatch

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Abstract: *There has been a worldwide energy crisis in recent years, leading to an increase in the demand for renewable energy resources. By using a hybrid power system, we can meet the need for energy while reducing our reliance on fossil fuels. This will help us to address the global energy crisis in a sustainable way. The non-renewable sources are going to be exhausted in a few decades more over it pollutes the environment in extreme level. The use of hybrid power systems can be beneficial to society in this case, as it supplies power at a constant rate and also can be eco-friendly when renewable source is available.*

Keywords: Hybrid, Power system, Renewable, Eco-friendly, Fossil fuels.

Introduction

World energy consumption has been on the rise worldwide as developing nations begin to industrialize and as consumers in developed nations buy more energy consuming appliances to make life more comfortable. If the current trends continue, we may face an energy shortage in future. All the energy on earth is derived from the sun. However, it occurs in various forms that today, man has developed the technology to exploit and use for agricultural, industrial and personal advancement. Energy used to power our lives can be divided into two types: Renewable and Non-renewable. Renewable sources are those sources that are continuously replenished by the action of the sun on the earth. They include wind, hydro-power, solar, bio- fuels and geothermal. Non-renewable sources are usually fossil fuels whose supplies will one day run out. An exception is Nuclear power which, though a non-renewable, is not produced from a fossil fuel[1].

Energy is essential to everyone's life no matter when and where they are. This is especially true in this new century, where people keep pursuing higher quality of life. Among different types of energy, electric energy is one of the most important that people need every day. In this chapter, an overview is given on the world energy demand, electricity consumption and their development trend in the near future. The electric power generation technologies based on different energy sources are also reviewed in the chapter. Finally, the need for this research work is addressed and the scope of the research is also defined..The use of renewable energy as part of, or as the major contribution of, the power supply system can be very attractive for most of the remote places. It has already been demonstrated that hybrid power systems may constitute the most economical solution in many applications, and may also provide a more reliable supply of electricity through the combination of several energy sources. The possibility of using local energy resources, i.e. renewable energy sources (sun, wind, water flow, biomass, etc.), which can be found almost everywhere including remote areas, is an appealing solution from the economic and logistic points of view.

The already matured renewable energy industry can provide efficient and reliable components for integration into power supply systems and the cost of components is expected to continue declining. However further improvement of the design and operation of hybrid power systems is still needed to allow the widespread application of this technology to the electrification schemes of remote areas.

Social, economic and industrial growth of any country requires energy. Fossil fuels are the major energy sources, which have been over- utilized leading to disastrous effects such as air pollution and destruction of the environment. Burning of fossil fuels releases harmful gases, that have severe consequences on the habitats and also effects human health [1]. They are non- renewable sources of energy as they are derived from pre-historic fossils and are no longer available once used. Their source is limited and they are being depleted at a faster rate. Renewable energy generation is a good option for protecting the environment as well as a solution towards the limited availability of fossil fuel.

The increasing energy demand, high energy prices, as well as concerns over environmentalist, health and climate change, have attracted many researchers and communities to move into alternative energy studies. Many studies have been done to make use of renewable energy sources (e.g. solar, biogas and wind) that are standalone [2], [3]. Among these, solar and wind energy are two of the most promising renewable power generation technologies. Solar power or wind power is normally used by remote off-grid areas where mains electricity supply is unavailable. The disadvantage of standalone power systems using renewable energy sources is that their availability is acted by daily and seasonal patterns which results in difficulties in regulating the output power to the load [4]. For example, actuating daily wind speeds and solar irradiation cut-off at night and cloudy days, leads to solar and wind systems with low reliability in supplying the load throughout a day. Since neither solar power nor wind power is available constantly throughout the day, month or year, exclusive solar or wind power systems cannot be used on stand alone basis for electrical installations which require constant guaranteed power. A good alternative to this is the use of hybrid energy systems [1].

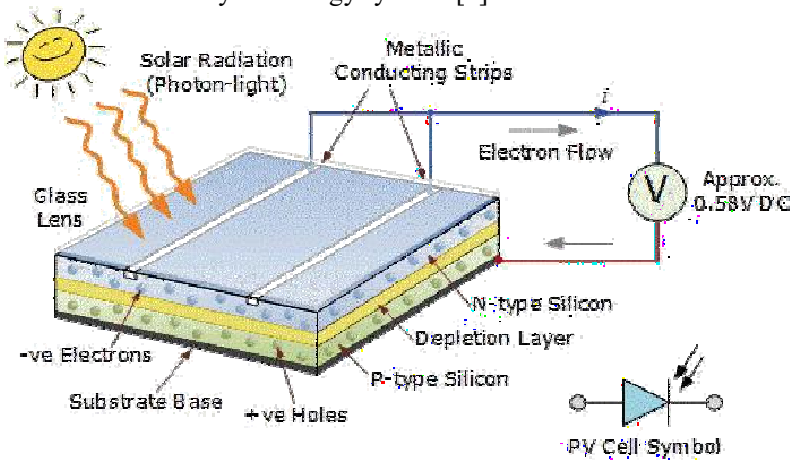

Figure 1: Schematic Block Diagram of PV Cell.

II. METHODOLOGY

1.1 THE HYBRID POWER SYSTEMS MODELS

Several models have been specifically developed to improve analysis and design of hybrid power systems. Comparisons and reviews of the available models can be found in Jeffries [2], Skarstein et al. [3] and Infield et al. [4].

The wind-diesel community, which are the researchers and specialists who work with hybrid power systems based mainly on the use of wind power combined with diesel generation, has been employing various ways of grouping the different models. For example, Infield et al.

[4] separates the two main groups of logistic and dynamic models; McGowan et al. [5] classifies them into four groups according to the mathematical equations used to describe the components' behavior; and Skarstein et al. [3] groups them as time-series and statistical depending on the approach to modelling.

In this work the wind-diesel models classification is relabeled and slightly redefined into four categories with the objective of comparing with the electrical power systems models classification, and to avoid

some of the inconsistencies of the previous wind-diesel classifications. This new classification is described below and the comparison with the wind-diesel community and the electrical power systems..

III. HYBRID SYSTEM MODEL AND BLOCK DIAGRAM

Hybrid power plant consists of mainly the solar cells, wind & DG. The energy is produced from the combination and is fed to the load via hybrid controller, the function of hybrid controller is to allow the energy sources to supply the load separately or simultaneously depending on the availability of the energy sources. Figure 4.1 shows the block diagram of hybrid power station consisting of solar wind and diesel generator. A hybrid controller is usedto manage the optimal power flow in the system.[1]

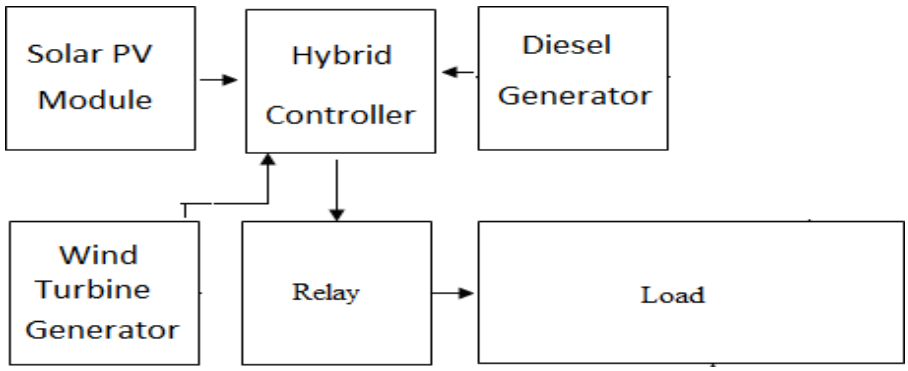

Figure 2: Hybrid block diagram.

III. RESULTS

UTPUT OF CONTROLLER DESIGNED FOR CONTINUOUS MODE HYBRID POWER STATION

Figure show the output voltage of continuous mode hybrid power station controller. The output of hybrid power station is fed to the multiport relay based controller. The function of controller is to minimize the use of diesel generator and maximize the use of renewable sources.

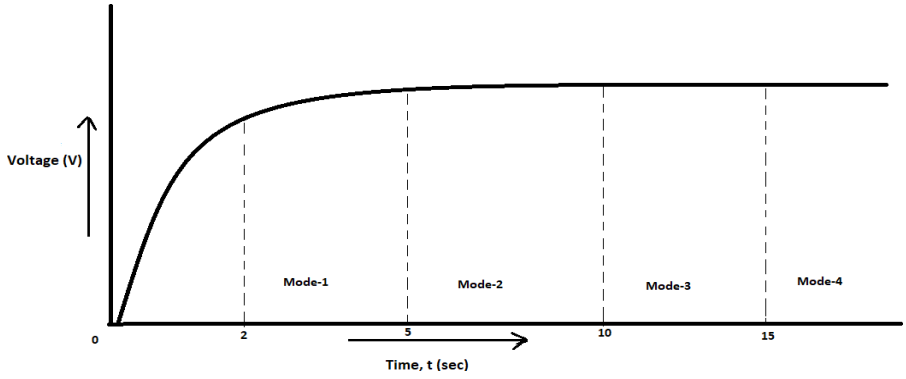

Figure 3: Output voltage of continuous mode hybrid power station

VALUATION OF CONTINUOUS MODE HYBRID POWER STATION

Figure 4 (a) shows the power generated by solar, wind and diesel generator. The average power generated by solar PV is approximately 6 kW. Wind energy generates up to 10kW depending on load demand. Diesel engine is switched off when total generated power reaches 5kW. The load power in kW consumed by resistive main load, additional load and dump load is plotted

in Figure 4(b) The breaker for first additional load bank is closed when both solar PV and wind energy conversion system is in operation and empowering 10kW main load. Another breaker for second additional load is closed when total power generation reaches 12.5kW.

In order to regulate the frequency, all dump loads are being added along with additional loads between 0.8s to 1.5s. The frequency regulator turns them off gradually when the frequency isstable at 60Hz after 1.5s.

Figure 4(c) shows the regulation of voltage at load side and the status of system frequency. Some fluctuation in load voltage is noticed between the period of 0.6s to 0.8s when both solarand wind energy are added in operation. The system frequency is being affected during the same period due to same operation.

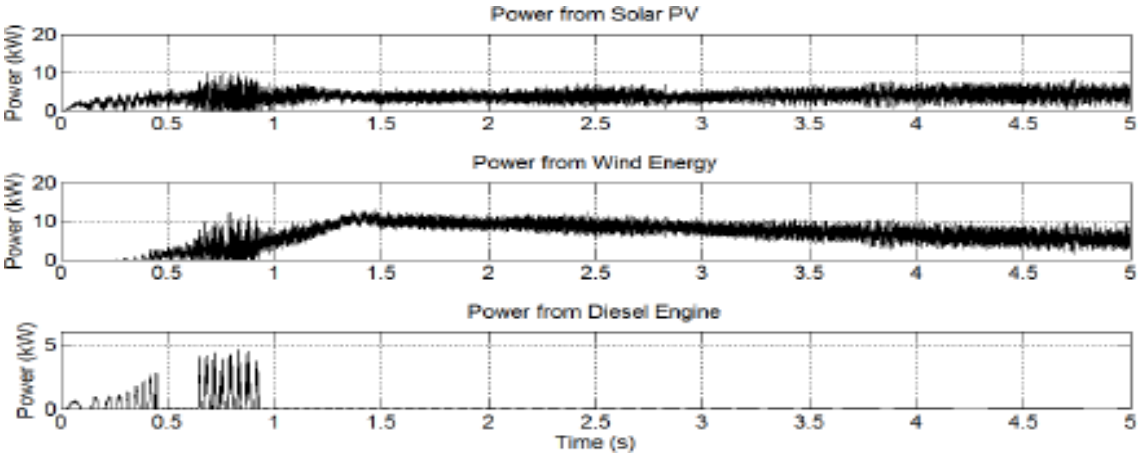

Figure 4(a) : Power generated by solar, wind and diesel generator

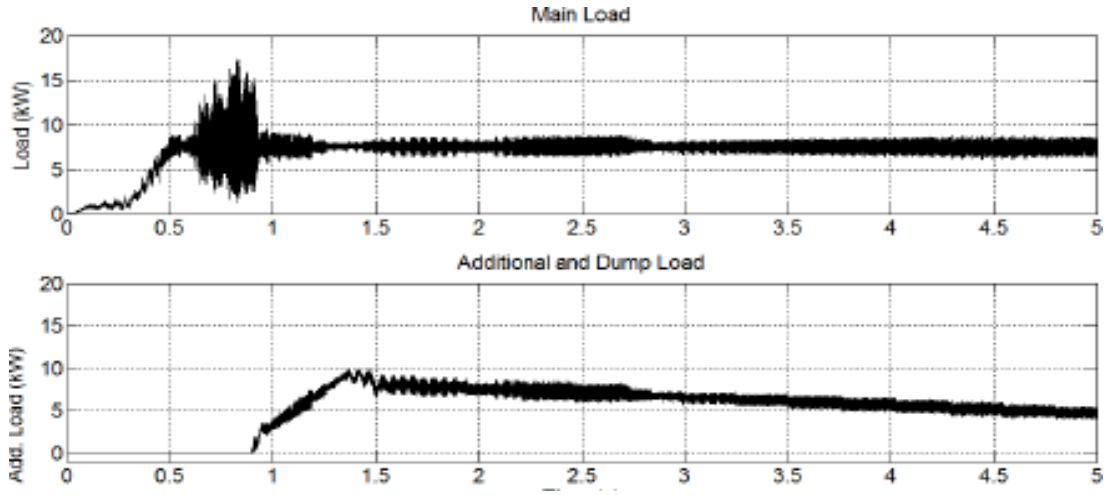

Figure 4 (b): Power consumed by resistive main load, additional load and dump load inKW

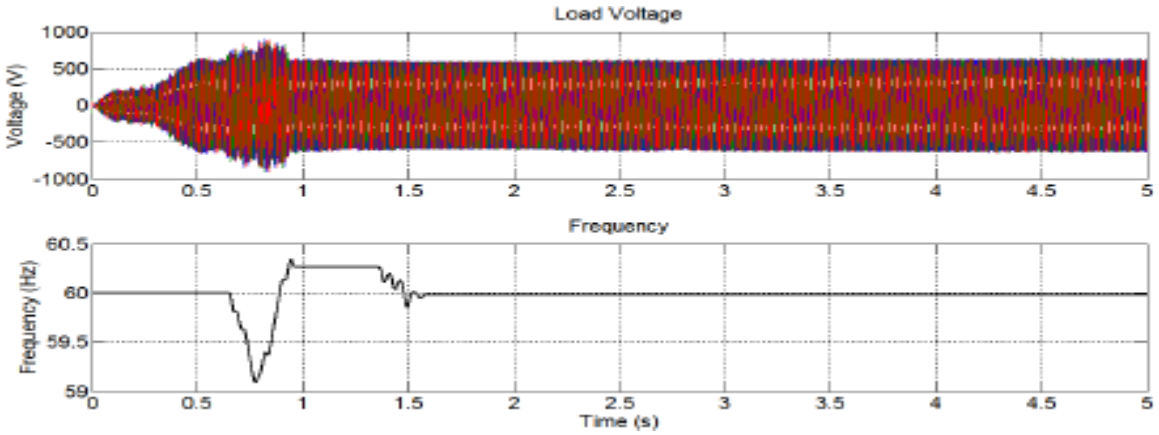

Figure 4 (c): Voltage regulation at load side and status of system frequency.

IV. Conclusion

This study presents an elaborative model of a continuous mode hybrid power station. The simulation model is developed to study the behavior of continuous mode solar-wind-diesel plant. In this paper the mathematical model of solar and wind energy conversion system is described. Both solar and wind energy conversion system consists maximum power point tracking and voltage regulation technique. A simple power management supervision control strategy is developed to analyze the reliability of hybrid energy system. A set of resistive dump load is applied to regulate the system frequency. Continuation of this work will include control systems to minimize the transient effects during different mode of operation and frequency regulation with energy storage.

References

[1] Chen, X., & Li, K. Collective information-based particle swarm optimization for multi- fuel CHP economic dispatch problem. Knowledge-Based Systems, 248, 108902. Doi:HTTPs://doi.org/10.1016/j.knosys.2022.108902, 2022.

[2] Xiong, G., Shuai, M., & Hu, X. Combined heat and power economic emission dispatch using improved bare-bone multi-objective particle swarm optimization. Energy, 244, 123108. Doi: HTTPs://doi.org/10.1016/j.energy.2022.123108, 2022.

[3] Arpan Dwivedi & Yogesh Phariya. Design and Analysis of 1.4 MW Hybrid Saps for Rural Electrification in Off-Grid Applications, International Journal of Energy and Power Engineering Vol:11, No:11, 2017.

[4] Anagreh Y., & Al-Ghzawi, A. (2013). Feasibility of utilizing renewable energy system for a small hotel in Ajloun city, Jordan. Applied Energy, 103, 25-31.

[5] Anagreh Y., & Bataineh, A. (2011). Renewable energy potential assessment in Jordan. Renewable and Sustainable Energy Reviews, 15, 2232-2239.

[6] Anayochukwu, A.V., & Ndubueze, N. A. (2013). Potentials of Optimized Hybrid System in Powering Off-Grid Macro Base Transmitter Station Site. International Journal of renewable energy research, 3(4), 861-871.
[7] Angelopoulos, K. (Glasgow 2004). Integration of Distributed Generation in Low Voltage Networks. Power Quality in Energy Systems and Environment. M.Sc. in EnergySystem and Environment.

[8] Dunlop, J. P. (2010). Photovoltaic systems (2nd ed.). Illinois: American TechnicalPublishers Inc.

[9] Fahmy, F. H., Ahmed, N. M., & Farghally, H. M. (2012). Optimization of Renewable Energy Power System for Small Scale Brackish Reverse Osmosis Desalination Unit and a Tourism Motel in Egypt. Smart Grid and Renewable Energy, 3, 43-50. http://dx.doi.org/10.4236/sgre.2012.31006.

[10] Farret, F., & Simoes, M. (Inc. IEEE PRESS, 2006). Integration of Alternative Sources of Energy. New Jersey: John Wiley and Sons.

[11] Ani Vincent Anayochukwu., 2014, "Optimal Energy Management System for PV/Wind/Diesel-Battery Power Systems for Rural Health Clinic". Global Journal of Researches in Engineering: General Engineering. 14 (1): 27-34.

[12] Dufo-Lopez, R. & Bernal-Agustin, J., L. 2009. "Multi-objective design and control ofhybrid systems minimizing costs and unmet load". Electric Power Systems Research,79:170-180.

[13] DufoLopez, R., Bernal-Agustin J. L. & Rivas-Ascaso, D.M., 2006, "Design of isolated hybrid systems minimizing costs and pollutant emissions". Renewable Energy 31: 2227-2244.

[14] Siew Fang Woon., Volker Rehbock. & Ahmad Agus Setiawan., 2008, "Modeling A PV- Diesel-Battery Power System: An Optimal Control Approach". Proceedings of the World Congress on Engineering and Computer Science. 1-6.

[15] Ashari, M. & Nayar, C.V., 1999, "An optimum dispatch strategy using set points for a photovoltaic (PV)-diesel-battery hybrid power system". Solar Energy, 66(1): 1-9.

[16] Tazvinga, H., Xia, X. & Zhang, J., 2013, "Minimum cost solution of photovoltaic- diesel-battery hybrid power systems for remote consumers". Solar Energy, 96: 292-299.

[17] Wu, Z. & Xia, X., 2015, "Optimal switching renewable energy system for demand side management". Solar Energy, 114: 278-288.

[18] Ghosh, G.C., Emonts, B. & Stolen, D., 2003, "Comparison of hydrogen storage with diesel generator system in a PV-WEC hybrid system". Solar Energy, 75:187- 98.