International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 3, May-June-2020, ISSN (Online): 2395-566X

Design of Diesel Generator and Solar Plant Hybrid Power Generation System with Improvement of Plant Efficiency

M.Tech. Scholar Shahrukh Mansuri
Dept. of Mechanical Engineering
Lakshmi Narain College of Technology & Science (R.I.T.),
Sanwer Road, Indore (M.P.) – 453111

Hod Nilesh Sharma
Dept. of Mechanical Engineering
Lakshmi Narain College of Technology & Science (R.I.T.),
Sanwer Road, Indore (M.P.) – 453111

***Abstract* – Handwritten signature verification system is a technology that can improve security in our day to day transaction held in society. Handwritten Signature Verification approach for offline signature verification. In offline signature verification, we are using neural network approach is project. Firstly, we need to train the system from a set of signatures. The images of signature are captured from a camera or it is scanned. The collected images are processed and their geometrical and statistical features are extracted. The extraction process is done using the SIFT algorithm. Then, the signature to be verified is taken as input in the same way. Feature extraction is also done for input image. Now, the input image features and the other images features in database are compared and classified. The classification algorithm used here is SVM and DTC algorithm. The classification process gives an exact classification whether the input signature is accepted or not. Handwritten Signature Verification technique is suitable for various applications such as bank transactions, passports with good authentication results etc.**

***Keywords*– Autonomous pv-diesel, unit sizing, distributed generation, energy flow, thermal parameters.**

I. INTRODUCTION

Public interconnected power grids are composed of complex combinations of generation plants, substations, transformers and transmission lines, which supply electricity to cities, businesses and industry. In addition, there are smaller independent power grids that provide power to islands or remote areas, which have limited or no access to public interconnected grids [1]. Connecting these areas and regions to the public grid is a time and money consuming process or in some cases physically impossible [2]. Traditionally, small stand-alone grids are electrified by diesel generators [1]. However, the renewable energy resources are attractive sources of power, since they can provide sustainable and clean power. Hybrid plants can be an integration of diesel generators with renewable energy resources such as photovoltaic. In addition, integrating a battery energy storage system (BESS) with the hybrid plant provides significant dynamic operation benefits such as higher stability and reliability of power supply [3]. Hybrid plants are outlined as an optimum approach for off grid power supply options for remote areas applications [4].

The hybrid plant must continually manage the fluctuations of the load and output power of the PV field to maintain the nominal frequency of the grid, which is a requirement for the satisfactory operation of power systems [5], [1]. According to the frequency control, the components of the plant are susceptible to variations in active power loading, because the frequency is dependent on the active power of the grid [5]. However, the variations in the output power of the diesel generators can lead to adverse effects on the operation such as increase of fuel consumption, maintenance, slobbering problems etc [6].

Active power control is analyzed according to primary control, which provides regulation in terms of few seconds, and secondary control, which provides much slower regulation [5].

In order to analyze the operation of the plant, the dynamic operation is run in the software Power Factory. Firstly, a model of diesel plant is implemented by integrating built-in models of diesel generator with its controllers and a load model, and then the models of three diesel generators are integrated with the load. Moreover, a model of fuel consumption measurement is developed in the paper and integrated. Then, a model of battery energy storage system is integrated with the diesel plant and load, and then a model of PV field is integrated with the plant. After that, the model is integrated with supplementary components such as lines and transformers. Finally, a model of secondary controller is developed in this paper and integrated with the model of the plant.

Four control strategies in relation to primary and secondary control of active power are proposed. Each control strategy leads to different performance and variations in the output power of the diesel generators and the BESS. The operation of the hybrid plant is analyzed according to each control strategy according to the results of the simulations. The simulation is run for an example day according to each control strategy. Furthermore, the four control strategies are compared according to the four criterions. Finally, an economical overview is performed by considering the difference of fuel consumption between the proposed control strategies.

II. RESEARCH MOTIVATION

The motivation of this paper is to analyze different control strategies in order to study options for improving the operation of PV-diesel generator-battery hybrid plants in stand-alone applications. The studied options focus on reducing the adverse effects of the variations in the load and the power of PV field. Accordingly, the operation cost can be reduced. Therefore, the active power control is analyzed, and the effects of the control strategy on the operation and costs of the plant are studied according to four criterions. The criterions are the frequency deviations, fuel consumption, expected lifetime of the batteries and the performance of the diesel generators.

III. TYPE OF THERMAL WITH SOLAR HYBRID SYSTEMS

Solar thermal energy is a ground-breaking technology for harnessing solar energy to produce heat energy. Solar thermal collectors can be classified as low or high-temperature collectors. Low-temperature collectors are flat plates typically used to warm swimming pools, heating water or heating air for residential and industrial use.

High-temperature collectors center sunlight using mirrors or lenses and is usually used for electricity power production. Solar Thermal Energy for electricity generation is totally different from the popular P.V, which converts solar power directly into electricity. Solar diesel generator thermal power plants convert the sunlight's energy to heat first and then to electricity through a series of processes. They are also referred to as concentrating solar power plants (CSPs). Solar tower, which is also a form of CSP captures and focus the sun's thermal energy with numerous tracking mirrors placed in a very large field. A tower is place the center of the heliostat field. The heliostats then focus concentrated sunlight onto the receiver which sits on prime of the tall tower. Within the receiver, the focused sunlight heats molten salt to above temperatures of 1,000°F (Kumar & Kumawat ,2013). The intense heated molten salt will then flow into a thermal storage vessel where it's then stored, sustaining 98 percent thermal potency, and then it's finally pumped to a steam generator. The steam spins a typical rotary engine to get electric power. This method, also called the "Rankin cycle" is comparable to a normal coal power station that uses coal as its fuel source, but in this case, it's been fueled by clean and free energy from the sun.

The inadequate supply of fossil fuels and also the negative effect of carbon dioxide emissions from the burning of fossil fuels on our environment give the increasing use and the need of renewable energy. Solar tower is one of the presumably technology for providing the bulk of this renewable/inexhaustible energy, because it is among the most cost-effective renewable energy technologies available.

IV. OBJECTIVE OF PROJECT WORK

The objective of this work is to analyze the different losses of a plant therefore to implant solutions in order to act in time and to improve its efficiency. Appropriate performance parameters can enable the performance engineer to either immediately correct performance or estimate when it would be cost effective to make corrections. In fact, the performance parameters measure how well a plant produces electricity.

- Improve plant operation;
- Predictive maintenance;
- Comparison of actual to expected performance;
- Improved efficiency of plant;
- Reduce uncertainty in actual costs for better MW sales.

The objective of this project work is to design double pipe and shell and tube heat exchangers which perform a given heat duty subject to pressure drop constraints and having optimum heat transfer area.

V. ISSUES OF OLD ARTICLES

"Design and application of fuzzy immune PID adaptive control based on particle swarm optimization in diesel generator thermal power plants" R. Bouchebbat, S. Gherbi:

The PID controller is the most used controller in the industry thanks to its simplicity and satisfactory performances, unfortunately there is a class of systems that can't achieve satisfactory performances with a simple PID controller as the nonlinear and the delayed systems. These last years, it appeared a lot of innovative control techniques as the bio-inspired methods, one of the most promising of them is the immune PID controller, it is inspired by the immune system regulating mechanism known by its robustness and self-adaptability.

In this paper, the immune feedback mechanism and fuzzy inference are incorporated to design a fuzzy immune PID adaptive controller while the particle swarm optimization (PSO) algorithm is used to optimize its parameters. The simulation results using a main steam temperature system as Controlled plant, verify that the strategy has strong adaptability to the transformation of the system parameters and has advantages of a good time performances and robustness ability. PID control is the most widely used control strategy in industrial process control, its algorithm control structure is very simple and can be tuned very easily, but for the time varying, uncertain and nonlinear characteristics, it can't achieve satisfied control performances. Artificial immune system as an intelligent information processing system is an emerging field of researches on control, optimization, pattern recognition, classification and other fields. According to [1,2] the immune cells role in promoting and inhibiting the immune response in the adjustment process, it can guarantee to obtain fast response and adequate stability. Although this response mechanism needs further exploration, but as a mechanism for biological information processing engineering, the immune regulatory mechanisms can be used to effectively improve the performance of the control system.

"Artificial intelligence based optimization algorithm for thermal power generation scheduling incorporating demand response strategy" Oliver Dzobo:
A dynamic combined economic emission dispatch(CEED) problem incorporating demand response strategy is performed. The demand response optimization problem is solved using a no convex mixed binary integer programming technique. Fixed and flexible loads connected to the power system network are considered in the analysis. Optimization of the dynamic CEED problem is done using particle swarm optimization (PSO) technique. The algorithm developed isable to take into account the thermal power generation unit ramp rates and power generation constraints. Conventional Lambda iterative method is used to validate the proposed PSO algorithm. The results show that the proposed PSO algorithm performs better than the conventional Lambda iterative method.

The current increase in energy demand in the national power system grid has caused a rise in fuel consumption costs and emissions into the environment from the conventional thermal power generation units [1]. Power system optimization has therefore become an important integral part of power system management as power system operators and managers try to balance energy demand with thermal power generation units' fuel consumption costs and emissions. Commonly, economic load dispatch has been investigated extensively and several optimization algorithms have been developed [2]. The economic load dispatch problem optimize the scheduling of thermal power generation units based on their fuel consumption costs. Emission constraints of thermal power generation units were added to the economic load dispatch problem to formulate a combined economic emission dispatch (CEED) problem. The scheduling optimization problems have always been done in isolation of optimized power system network load demand [3]. The problem with such analysis is that suboptimal solutions are obtained as a result of neglecting the load shifting capabilities of the loads connected to the power system network. In this paper, a dynamic CEED incorporating demand response strategy is performed. Flexible and fixed loads connected to the power system network are considered.

"Prediction of Thermal System Parameters Based on PSO-ELM Hybrid Algorithm" Liangyu Ma, Lijuan Zhao, Xiaoxia Wang:
Parameter prediction with high precision isof great importance for real-time condition monitoring and fault diagnosis of the thermal system during variable load process. This paper presents a performance enhancement scheme for the extreme learning machine(ELM) to predict the operating parameters of the thermal system using particle swarm optimization (PSO). ELM is afeed-forward neural network with single hidden layer,which has well generalization ability and fast learning ability. However, the number of the hidden layer nodes ofELM could not be automatically obtained. The optimal selection of ELM parameters can improve its performance.

In this paper, the discrete-valued PSO is applied for optimizing the number of the hidden nodes to enhance ELM performance. The simulation results show that the proposed hybrid algorithm is more accurate and effective for predicting thermal system parameters. A large-scale coal-fired power unit is a complex thermal system with lots of operation parameters and variable loading Conditions. To acquire the normal reference values of the feature parameters accurately under different loading conditions is of great importance for fault diagnosis [1].

However, the most of operation parameters are difficult to quantitatively calculate by mathematical relationships, which Could be predicted via some specified methods. At present, BP, Elman and some multi-stage neural networks have been widely applied in parameter prediction of thermal system [2-4]. Extreme Learning Machine (ELM) method proposed by Huang et al [5] in 2006, is widely used in classification, regression, power generation prediction and wind speed prediction [6-9] due to its characteristic of good generalization capability and simple training. However, random determination of input weights and difficult acquisition of hidden layer node are the defects of ELM algorithm.

In recent years, intelligent algorithms based on bionics have been widely used in parameter optimization, such as Genetic Algorithms (GA) [10], Particle Swarm Optimization (PSO) [5-10] and Firefly Algorithm (FA) [1]. Therefore, considering the nonlinear characteristics of thermal system under variable loading conditions, this paper presents an optimization scheme for the ELM for parameter prediction of the high-pressure feed water heater system using PSO algorithm.

VI. PHYSICAL DESCRIPTION OF DIESEL GENERATORS

A diesel generation unit is composed mainly of a diesel engine and a synchronous generator rotating on one shaft. The diesel engine provides the active power by converting the chemical energy of the fuel into mechanical energy, which is represented by the mechanical torque on the rotating shaft. On the other hand, the excitation system of the synchronous generator determines the reactive power by the excitation current in excitation windings of the rotor [2].

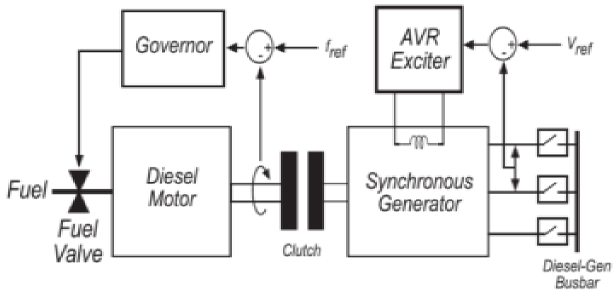
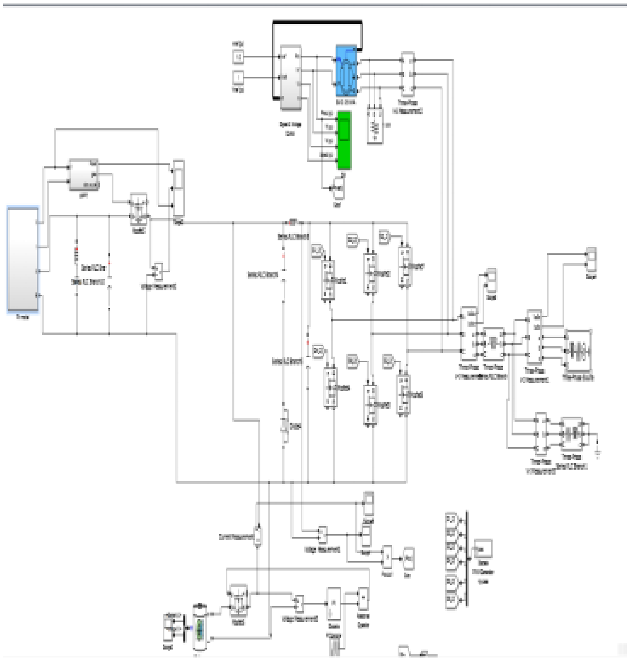


Fig.1. General structure of diesel generators [2].

The diesel engine is a reliable source of power that can provide power whenever it is needed according to its rated power, provided that the fuel is available. The diesel engine needs a governor to control the output power and the speed of the generator. The governor adjusts the fuel valve (throttle) in order to control the fuel rate according to load variations on the shaft [2].

VII. RESULT AND SIMULATION



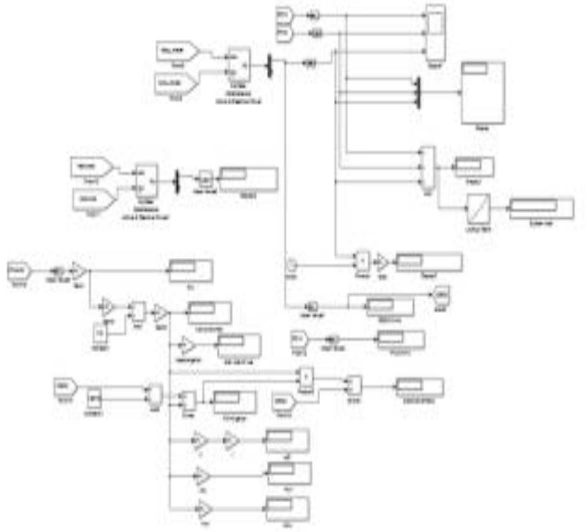


Fig.2. Simulink Modelling of All system.

Fig 2 shows Hybrid modeling of two power generation system like as solar and thermal plant. This is also connected to battery system to provide continuity across load. With PI controller are control response time.

VIII. CONCLUSION

The simulation results show that the control strategy, which covers the power fluctuations mainly from the battery system, demonstrates more constant output power of diesel generators, lower frequency deviations, less fuel consumption, better performance of the diesel generators and less cost of energy, but less expected lifetime of the batteries compared to the other analyzed control strategies. On the other hand, the control strategy, which covers the power fluctuations from the diesel generators and the battery system in parallel, demonstrates higher variation in output power of the diesel generators, higher frequency deviations, higher fuel consumption, less favorable performance of the diesel generators and higher cost of energy, but higher expected lifetime of the battery compared to the other analyzed control strategies.

In this paper, the dynamic operation of a hybrid PV-diesel generator-battery plant in off grid power supply is simulated in Power Factory. The primary and secondary control of active power is considered to compensate the active power fluctuations, which result from the variations of the load and PV field power. Four control strategies are proposed to represent different contribution to the primary and secondary control between the battery energy storage system (BESS) and the diesel generators.

1. Control strategy (1): the primary control is provided by the diesel generators and the BESS in parallel, and the secondary control is provided only by the BESS.

2. Control strategy (2): the primary and secondary control is provided by the diesel generators and the BESS in parallel.
3. Control strategy (3): the primary and secondary control is provided mainly by the BESS.
4. Control strategy (4): the primary control is provided mainly by the BESS, while the secondary control is provided by the diesel generators and the BESS in parallel.
5. The control strategies are compared according to four criterions; the frequency deviations, fuel consumption, the expected lifetime of the batteries and the performance of the diesel generators.

The results show that each control strategy leads to a different level of variations in the output power of the diesel generators and the BESS. Control strategy (3) leads to more constant output power close to the nominal value of the diesel generators, whereas control strategy (2) leads to a higher level of variations in the output power of the diesel generators, while control strategy (4) and (1) lead to the second and third higher levels of the variations in the loading of the diesel generators respectively.

REFERENCES

[1]. Altair-nano. (2012, January) Overview of the Microgrid and the role of storage to reduce cost and improve stability. [Online]. http://www.altairnano.com/Microgrid_Energy_Storage
[2]. B. Sedaghat, Design of a multilevel control strategy for integration of stand-alone wind/diesel system, A. Jalilvand and R. Noroozian, Eds. Zanjan, Iran: Elsevier Ltd., 2011.
[3]. D Kottick, M Blau, and D Edelstein, Battery Energy Strorage for Frequency Regulation in an Island Power System, 3rd ed.: IEEE Transactions on Energy Conversion, 1993, vol. 8.
[4]. S. Rehman and L. Al-Hadhrami, Study of a solar PV-diesel-battery hybrid power system for a remotely located population near Rafha, Saudi Arabia. Dhahran, Saudi Arabia: ScienceDirect, 2009, vol. 35.
[5]. P Kundur, "Vice-president, Power Engineering," in Power System Stability And Control, J Neal and G Mark, Eds. Palo Alto, California, USA: McGraw-Hill, 1994.
[6]. J. Manwell, W. Stein, A. Rogers, and J. McGowan, An investigation of variable speed operation of diesel generators in hybrid energy system, 6th ed. Amherst, Massachusetts, USA: ScienceDirect, 1992, vol. 2.
[7]. Basler Electric Company. (2011, July) Parallel Operation. [Online]. http://www.basler.com/
[8]. Version 14.1 PowerFactory, Built-in models in the library of PowerFactory. Gomaringen, Germany: DIgSILENT, 2011.
[9]. Version 14.1 PowerFactory, User's Manual, 1st ed. Gomaringen, Germany: DIgSILENT, 2011, vol. 2.
[10].[10]Version 14.1 PowerFactory, User's Manual, 1st ed. Go