INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 6 Issue 1, July – Sep. 2020 - www.ijrmmae.in – Pages 9-13

Hybrid Power Generation Using Solar and Wind

Harish Mudegonnavar[1*], Neelakanthareddy Y B[2], Siddesh N Bevinahalli[3]

[1] Harish Mudegonnavar, Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205 (harishsm.mech@gmail.com)
[2] Neelakanthareddy Y B, Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205
[3] Siddesh N Bevinahalli, Mechanical Engineering, R. T. E. Society's Rural Engineering College Hulkoti, Gadag, Karnataka, India-582205

ABSTRACT

Parabolic trough solar power plants are the most proven system of concentrating solar power (CSP) techniques. There are nine parabolic troughs solar electricity generating system (SEGS) in California, USA illustrates the capability of this technology to be a reliable, renewable energy resource. This system has been operating commercially as large-scale thermal solar power plants with a total output of 345 MW. CSP plants are promising technologies to be the alternative clean energy resource to meet the increasing energy demand and thus reduce the environmental impact. It is predicted that CSP will play a significant are increasing rapidly in response to the growing economics in both developed and developing countries.

INTRODUCTION

AS well known the main resources of energy in Libya are oil and gas which results in high emission of carbon dioxide and other gases. As the modern world consistently emphasizes on using renewable energy to generate electricity, which is harmless to the environment. Hybrid power plant is a new developed technology that is used to convert solar energy with any system that generates energy. Parabolic trough solar power plants are the most proven system of concentrating solar power (CSP) techniques. There are nine parabolic troughs solar electricity generating system (SEGS) in California, USA illustrates the capability of this technology to be a reliable, renewable energy resource. This system has been operating commercially as large-scale thermal solar power plants with a total output of 345 MW. CSP plants are promising technologies to be the alternative clean energy resource to meet the increasing energy demand and thus reduce the environmental impact. It is predicted that CSP will play a significant are increasing rapidly in response to the growing economics in both developed and developing countries. Electricity produced by CSP in the Mediterranean and

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North African (MENA) region can be used to improve the local energy production systems and can be exported to the EU. It aims at interconnecting the electricity grids of the Mediterranean, North Africa regions Europe, generating power by employing CSP in MENA and exporting it to the EU using a high voltage direct current HVDC network. The goal is to export about 700 TWh/year to the EU by 2020.]. Ensuring energy security, energy resources used in the country in the future need to be diversified. Also to ensure the continuity of supply, energy mix need to be rationalized considering important factors, such as economic cost, environmental impact, reliability of supplies and convenience to consumers. The hybrid renewable power generation is a system aimed at the production and utilization of the electrical energy stemming from more than one source, provided that at least one of the stemming from more than one source, provided that at least one of them is renewable. Through this project it is expected to give concern about development of the wind-solar hybrid power generation systems where wind solar potential is high in Libya. Under this project, solar energy and wind energy potentials are going to be investigated at geographically location in Libya by collecting data from different sources. Then selected location are going to be analysed.

PROBLEM IDENTIFICATION & MOTIVATION

With the world oil crisis, dangers of overdependence on oil pushed for the development of alternative energy sources. Current international trend in electricity generation is to utilize renewable energy resources. Solar, wind, biomass, micro hydro systems can be seen as suitable alternatives to conventional power. With the expectation of promoting electricity generation based on non-conventional renewable energy.

OBJECTIVES OF THE PROJECT

The main objective of the project is to design and assess the performance of a wind-solar hybrid system for electricity generation at a chosen location in Libya.

WORKING METHODOLOGY

Hybrid Power Generation System

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system. Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system solar and wind power is used for generating power. Solar and wind has good advantages than other than any other non conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system. There is a growing need for energy throughout the world. This in satiable demand is being driven from an ever expanding growth from the middleclass of people in emerging economies looking to avail themselves of conveniences and tools that are normally taken for granted. Additionally, the worldwide explosion of technologies of all types, including personal electronics, mobile devices, and (quality of life) conveniences, place a greater demand or strain on traditional grid or utility supplied energy sources.

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Hybrid systems that use renewable energy sources, such as solar and wind resource, may be feasible and an alternative to supply electricity to remote or isolated areas from the national grid and help in reducing the use of fossil fuels, dependence on costly fuel, and reduce the emission of greenhouse gases. there are problems in utilizing the solar as well as wind energy efficiently.

DESIGN STEPS OF A WIND FARM

1Preliminary site identification
2detailed technical and economic analysis
3Environment, social and legal appraisal
4micro-sitting and construction

The first step in the development of a wind farm is to identify a suitable location, having reasonably high wind velocity. Once the broad geographical region for the development of the proposed wind farm is identified, it may be possible to locate several sites which could be used for constructing the wind farm. Wind data available from local weather stations, airports etc. or published documents like wind maps may be used for this purpose. A candidate site must usually have a minimum annual average wind speed of 5 m/s. our location and site identification have reasonably wind velocity 6 m/s .Once such sites available in the region are identified, computer models are used for estimating the energy potential of these sites in different time frames .

The Hybrid Optimization Model for Electric Renewable (HOMER), which is copyrighted by the Midwest Research Institute (MRI) is a computer model developed by the US National Renewable Energy Laboratory (NREL) to assist the design of power systems and facilitate the comparison of power generation technologies across a wide range of applications [HOMER, ver.2.81 Beta]. HOMER is used to model a power system physical behaviour and its life-cycle cost, which is the total cost of installing and operating the system over its life time. HOMER performs three principal tasks, simulation, optimization and sensitivity analysis based on the raw input data given by user. In the simulation process, the performance of a particular power system configuration for each hour of the year is model to determine its technical feasibility and lifecycle cost. HOMER can simulate wide variety of power system configurations, comprising any combination of PV array, wind turbines, run off-river hydro turbines, generators and battery bank systems with grid connection or off grid that can serve electrical loads and thermal loads. The simulation process serves two purposes. First, it determines whether the system is feasible. Second, it estimates the lifecycle cost of system, which is the total cost of installing and operating the system over its lifetime.

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RESULTS ANALYSIS

In this chapter, results of the designed wind-solar hybrid power generation system are presented and the conclusions from the findings are drawn.

Simulation

HOMER simulates the operation of a system by making energy balance calculations in each hourly time step of the year. For each time step, HOMER compares the electric demand in that time step to the energy that the system can supply in that time step. Then calculates the flows of energy to and from each component of the system. HOMER performs these energy balance calculations for each system configuration that wants to be considered. It then determines whether a configuration is feasible, i.e., whether it can meet the electric demand under the specified conditions, and estimates the cost of installing and operating the system over the lifetime of the project. The number of installed 100kW wind turbines is varied from 0 to 10 and the PV modules and converter sizes are varied between 0, 150kW for the estimations of the proposed system variation in size and type of configuration.

Optimization

After simulating all of the possible system configurations, HOMER displays a list of configurations sorted by net present cost (NPC), i.e. lifecycle cost, which can be used to compare the different system design options. The NPC of a component is the present value of all the costs of installing and operating that component over the project lifetime, minus the present value of all the revenues that it earns over the project life time. HOMER calculates the NPC of each component in the system, and of the system as a whole. Figure 5.1 shows the categorized HOMER optimization results. In each category of diffident design type it shows only the lowest NPC configuration.

CONCLUSION

The present worldwide trends concern energy security and sustainable development across the globe. The role of renewable energy has therefore become ever more significant. The developed world is already on the track for walking out from the fossil fuel era and involving mainly the areas of renewable energy technologies and energy efficiency. Through this study an insight into the energy situation and renewable energy potential of Libya was given. It was identified that Libya has economically feasible power generation potential of wind and solar energy. Using HOMER simulation software a grid tied wind-solar hybrid power generation system was modelled for a selected location in the almarj area of Libya (MARJU), located on the coastal belt near Benghazi. Through the simulation process, installation of 10 numbers of 100Kwwind turbines and 150kw solar PV array was identified as economically most feasible design to supply average load connected to grid where payback period of the design is 2.6 years.

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