Review of Solar Powered Stirling Engine for Generating Electricity

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Abstract— Solar Power Stirling engine have great potential in countries with huge amount of solar radiation. It has ability to utilize effectively any burner fuel, such as wood, rice husk, straw, agricultural west and other readily available and cheap combustibles. The Stirling engine that operates by cyclic compression and expansion of air or other gas, the working fluid, at different temperature level such that there is net conversion of heat energy to mechanical work.

Keywords: Solar Dish-Stirling, grid connected, Parabolic trough collector

I. INTRODUCTION

Due to the rapid growth of power electronics techniques, applications with renewable energy conversion systems are increased significantly. There are different kinds of renewable energy associated with available energy storage units produces an hybrid energy system. The hybrid power system are higher reliability with the advantage of reducing blackouts affecting the power grids. The system performance in this paper is Dish-Stirling system is used instead of PV array due to their high reliability and important efficiency. Dish-Stirling systems exceed the efficiency of any other solar conversion technology. The hybrid wind-Dish-Stirling system is connected to the utility distribution grid is developed. The grid is evaluate in different condition connected in hybrid system performance.

Solar Power Stirling engine have a number of advantages compare to other with renewable energy conversion systems.

- Higher efficiency
- Long operation life
- Very great reliability
- Requiring little maintenance

The major components of a parabolic trough collector are parabola reflector (collector), receiver tube, supporting structure and tracking mechanism [1]-[2]. Solar collectors are special type of heat exchangers that can transform solar energy into thermal energy through transport medium like air, water, oil etc. Solar collectors are of two types, concentrating and non-concentrating [1]. They are a low cost alternative to parabolic trough systems since the low curvature or flat mirrors can be made by cheaper off-the-shelf components and require less land area to provide the same power output.

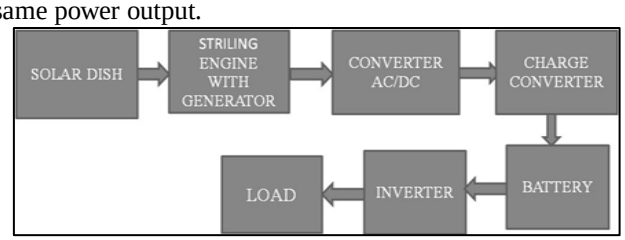

Fig. 1: General block diagram

A solar-thermal power system converts solar energy into electrical power utilizing the heat captured by a solar collector [3]. The parabolic dish concentrator concentrates solar radiation onto the thermal receiver, which then provides the thermal energy to drive a Stirling engine. The receiver is comprised of an aperture and an absorber. [2] The aperture of the receiver is placed at the focal point of the parabolic concentrator. A solar dish concentrator design with a rim angle of 45◦ is propose in several investigations, that means is create the highest thermal performance and the highest concentration ratio.

In [3] the lumped-mass transient model is used to study temperature variations in the expansion and compression spaces as well as the shaft power output. The power output and the engine thermal efficiency of a powered Stirling engine is optimized and also used finite speed thermodynamic analysis and minimized total pressure losses. In [2] [3] [4] paper also developed a mathematical model based on the finite-time thermodynamics is developed to optimize the power output, thermal efficiency, and rate of the entropy generation, simultaneously, using multi-objective evolutionary algorithms. This approach is used to improve the performance based on a new design for its collector.

II. RELATED WORK

In [1] the design of solar parabolic trough collector is given as a demonstrative prototype. It was a solar collectors are special type of heat exchangers that can transform solar energy into thermal energy. In [2] the design process was useful in fabrication of solar parabolic trough collector .It was includes the design of two main parts reflector and receiver tube. In [3] the design of an pilot parabolic solar dish-stirling system had the annual energy production increase from 1.945 to 6.74 Gwh/year. When the dish diameter had increase 3 to 5m.

In [1]-[3] paper describe a grid converted generation model composed by dish-striling, AC/ DC converter, DC/AC inverter. The performance of solar dish-stirling system had affected by a solar radiation at the concentrator, the design parameter of the collector and the stirlng engine. In [4] the stirling engine assure the coupling between thermo mechanical part and electrical part by a generator tabular linear induction massive mover or inductive generator. In [4] the collector with parabolic dish diameter of 3m, a rim angle of 45degree and a concentration ratio of 625. The collector of pilot solar dish-stirling system result in significant increase in system performance.

In [5] the solar collectors are special type of heat exchangers that can transform solar energy into thermal energy through transport medium like air, water, oil ,etc. In [6] the hybrid electric power generation is constituted from free piston Stirling engine generator. [6] [7] The method of solar power Stirling engine by using self-generate electricity. A new power plants will typically burn natural gas which would be much efficient to generating electricity at your house. In [5] [6] The proper design for the collector

of pilot solar stirling system result in a significant increase in system performance. In [7] The design of the stirling engine represents the energy conversion unit which is responsible for the transformation from thermal into mechanical energy to be used by the electrical generator. Stirling engine is an external combustion engine working theoretically on closed regenerative Stirling cycle using hydrogen or helium as working fluids. [5] [7] The Stirling engine is a heat engines, cycles through four main processes: cooling, compression, heating, and expansion. [7] This is accomplished by moving the gas back and forth between hot and cold heat exchangers, often with a regenerator between the heater and cooler. It has the ability to utilize effectively and burnable fuel such as wood, rice husk ,straw, agricultural waste and other readily available and cheap combustibles.

III. Conclusion

It can be concluded that a proper design for the collector of a pilot solar dish-Stirling system results in a significant increase in system performance. [1] The results demonstrated the importance of the design of the collector on the system performances. [1] [2] Based on these results an appropriate concentration ratio is designs for the system. [3] We are used Matlab/Simulink software to implement the model Dish Stirling engine and electrical controllers. [4] The aim is to study the implement to control solar dish Stirling system when considering the mechanical speed as a new control variable that provides a new degree of freedom to simulate the process at any operation condition and provide satisfactory conclusion. [5] This technique is widely used with success in recent years in wind power generators.

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