International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

EXAMINATION AND OPTIMIZATION OF SOLAR THERMAL PLANT WITH DAILY THERMAL STORAGE

Traymbkeshwar Pathak, Nitesh Rane

PG Scholar, Dr. APJ Abdul Kalam University Indore, M.P., India
Assistant Professor, Dr. APJ Abdul Kalam University Indore, M.P., India

ABSTRACT

Due to rapid growth in infrastructure sector (i.e. communication, transport, road and rail networks, etc.), demand of energy is rising enormously and more than 20-30% demand is satisfied by non-conventional energy sources. Renewable or non-conventional energy sources are essential for the sustainable development, have many advantages over conventional energy sources like availability, environment friendly, etc. But the most important difficulty is the uneven generation of energy. Therefore, trustworthy and affordable energy storage system becomes a prerequisite for using renewable energy. Energy storage systems play pivotal role towards smooth and continuous energy supply. Energy storage system holds the generated energy for a short time and supplied it according to need. Therefore, energy storage system is the most capable technology to meet the rising demand of energy. A device that accumulates energy is sometimes termed as an accumulator. There are various energy storage systems. Paper presents brief overview of various energy storage systems. Many researches come on the conclusion that renewable energy sources are the only option for sustainable development and appropriate energy storage systems are the prerequisite. They have feature to store the energy and then release as and when required. Rapidly rising demand of energy, fast depleting and limited stock of fossil fuels, their serious environmental issues compel to shift towards to more use of renewable energy sources. There are some critical issues while using renewable energy sources like reliability, quality, etc. Energy storage systems have the capability to solve the problems up to some extent towards smooth and continuous energy supply.

INTRODUCTION:

In current state of affairs, requirement of energy is rising exponentially in every sectors i.e. manufacturing, infrastructure etc. Infrastructure sector (i.e. hospitals, restaurants, lodges, shopping complexes, educational big schools, colleges, corporate offices, multiuse etc.) is developing very speedy due to growing population, need of high comfort level due to advancement in people's living standard, energy consumption is increasing rapidly. Heating/cooling requirement of the building only consumes 30-34% of the total global energy consumption. They are resulting key problems in a variety are like pollution control, change in climatic conditions, global warming, ozone layer depletion etc. that creates many health issues. Right now, energy management and security are the globe priority topics. The Intergovernmental Panel on Climate Change (IPCC) has accepted that Green House Gases (GHGs) are the first and foremost responsible for the various environmental issues like climate change and global warming. Large numbers of researchers suggest that promoting more use of renewable energy would be the revolutionary way to control GHGs emissions. There are various renewable options available, choice of them must be according to satisfying various criteria i.e. techno-economic, environmental issues, geographical conditions, required energy quality, etc. Energy intensity and its 24×7 availability have become the main relative measures of countries. Energy use to Gross Domestic Product (GDP) is known as energy intensity. It's value usually higher for developing compare to the already developed countries. Higher value demonstrates huge energy dependence. India consumes approximately 6% of world's primary energy In India, 1363 MW was the total installed capacity in 1947. Then reached to 314.64 GW in 2017. During 2012-17 in the 12th Five Year, 88,425 MW target was set. Majority part means 50,000 MW was based on coal fired thermal power plant. Presently Major portion of power generation is based on coal, oil, gas, nuclear (70%), then hydro (17%) and renewable (13%). But due the limited stock and its environmental issues compel to move towards alternative source of energy (i.e. renewable-solar, wind, biomass, geothermal, ocean, hydrogen, etc.). The IPCC report (June 2011) on the climate change by 2050 share of renewable energy in global energy mix could arrive up to 77%.In India, in the 12th Five Year Plan (2012-17), target of 29,800 MW power capacity (i.e. renewable energy share more than 12% in terms of installed capacity) has been set from renewable energy sources. Currently energy consumption rate in India has reached to just double compare to year 2000. There are

mainly five major energy consuming fields i.e. industries, agriculture, transport, communication, buildings (i.e. commercial and residential). It can be classified as primary and secondary energy sources. Primary energy sources are normally categorized as renewable and non-renewable on the basis of their depleting characteristics, as shown in Fig. 1.1. Renewable energy derived from natural resources and they are automatically replenished. It is also known as clean energy sources

NEED OF STUDY

According to current rising trend in energy demand, reducing balance stock of fossil fuels and its impact on environment and health, it is urgent to switch over to alternative source of energy i.e. renewable with efficient storage systems.The objectives of the present work are to develop methodology for hybridizing the solar thermal (i.e. CSP) with thermal storage to 24×7 uninterrupted energy supply.

Objective-I

1. Experimentally performance analysis of 1 MWe (3.5 MW) solar thermal power plant with 16 hours thermal storage for continuous operation established at Mount Abu, Rajasthan.

2. Experimentally performance analysis of 3.5 kWe (1 kWh) solar thermal power plant with 24 hours thermal storage for continuous operation established at Bhopal, Madhya Pradesh.

Objective-II

3. To compare the performance of above mentioned both solar thermal power plant coupled with storage system for the Indian climate conditions.

After reviewing different research papers, following research gaps are identified:

1. Remarkable scope of energy storage is available coupled with solar thermal (CSP) systems in in hot climatic conditions i.e. India. Only a few concerned research papers are accessible for making available electricity 24×7 in hot climatic conditions i.e. India.

2. Thermal energy storage system (i.e. solid) coupled with solar thermal (CSP) systems for the Indian climatic conditions is not found

EXPERIMENTAL SET UP

Solution towards energy security and various environmental issues is the adoption and promotion of renewable energy systems. Solar energy has the tremendous scope of energy generation i.e. electricity and heat both. In this chapter, methodology adopted for CSP system with energy storage system is presented. The adoptability of solar thermal system can significantly be enhanced by coupling energy storage system.Title of the first experimental set up is "1MW electrical (3.5 MW thermal) solar power plant with 16 hours thermal storage capacity". The aim of the experimental set up is to establish a 1MW capacity solar thermal power plant with 16 hours storage facility based on Parabolic Solar Reflectors at an estimated solar to electric efficiency of about12%. Title of second experiment set up is "high energy density thermal energy storage for concentrated solar plant".

CONCLUSION:

Energy security, high efficiency with economy feasibility, sustainable development with environmental protection are the globally primacy topics. In present era the growth of population is very fast, resulting energy demand is also increasing exponentially mainly due to their modern life style, etc. Therefore, renewable based 24×7 energy solutions have to be invented. Conventional renewable energy generation systems have enormous issues i.e. uninterrupted supply, energy storage with controlled GHGs emissions. Unlike conventional renewable approach, an innovative passive hybrid approach is the coupling of energy storage system with Concentrated Solar Power (CSP) system. By using solar energy, the hybrid system is able to generate huge amount of energy. These systems are characterized by various advantages i.e. appropriate efficiency, no emissions of GHGs with very low operation and maintenance costs etc. Two experimental set ups with objective to proficient exploitation solar energy and store through solid storage systems to provide the power 24×7. A 1 MWe (3.5 MW thermal) solar power plant with 16 hours thermal storage capacity and A 1 kWe high energy density thermal energy storage for concentrated solar plant were experimented and found satisfactory results as per Indian climatic conditions.

REFERENCES:

1. Sharma A., Shukla A., Lu A., Low carbon energy supply, Green Energy Technology,

2018.

2. Dang A., Concentrators: A review, Energy Conservation and Management, 1986; 26(1):11-26.

3. Ummadisingu A., Soni MS., Concentrating solar power-Technology, potential and policy in India, Renewable and Sustainable Energy Reviews, 2011;15:5169-75.

4. Sinha AA., Thermal storage possibility in phase changing materials in CSP Technologies, International Journal for Scientific Research Development, 2017; 5(8):660-666.

5. Aiba T., Tamaura Y., Kikura H., Improvement of image processing control accuracy for cross linear heliostat, Solar Paces Proceedings, Japan, 2015; 69:1859-1867.

6. Aiba T., Tamaura Y., Kikura H., Image Processing for Cross Linear Heliostat Controlling System, Grand Renewable Energy Proceedings, Japan, 2014.

7. Avila-Marin AL., Volumetric receivers in solar thermal power plants with central receiver system technology: A review, Solar Energy, 2011; 85(5):891-910.

8. Gobreit B., Amsbeck L., Buck R., Pitz-Pall R., Assessment of a Falling Solid Particle Receiver with Numerical Simulation, Solar Energy, 2015;115:505-517.

9. Bauer T., Breidenbach N., Overview of molten salt storage systems and material development for solar thermal power plants,https://pdfs.semanticscholar.org. 1-8.

10. Jelle BP., Gustavsen A., Baetens R., The path to the high performance thermal building insulation materials and solutions of tomorrow, Journal of Building Physics, 2010; 34(2):99-123.

11. Cristina PC., Cooper P., Fernández A., Cabeza L., Review of technology: Thermo chemical energy storage for concentrated solar power plants, Renewable and Sustainable Energy Reviews, 2016; 60:909-929.