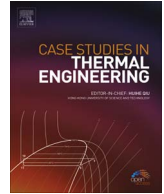




Contents lists available at ScienceDirect

Case Studies in Thermal Engineering

journal homepage: www.elsevier.com/locate/csite

Modeling and performance simulation of 100 MW PTC based solar thermal power plant in Udaipur India

Deepak Bishoyi^{a,*}, K. Sudhakar^{a,b}^a Energy Centre, Maulana Azad National Institute of Technology, Bhopal, India^b Faculty of Mechanical Engineering, Universiti Malaysia, Pahang, 26600 Pahang, Malaysia

ARTICLE INFO

Keywords:

Parabolic trough
Solar thermal power
SAM (System Advisor Model)
Simulation
India

ABSTRACT

Solar energy is a key renewable energy source and the most abundant energy source on the globe. Solar energy can be converted into electric energy by using two different processes: by means of photovoltaic (PV) conversion and the thermodynamic cycles. Concentrated solar power (CSP) is viewed as one of the most promising alternatives in the field of solar energy utilization. Lifetime and efficiency of PV system are very less compared to the CSP technology. A 100 MW parabolic trough solar thermal power plant with 6 h of thermal energy storage has been evaluated in terms of design and thermal performance, based on the System Advisor Model (SAM). A location receiving an annual DNI of 2248.17 kW h/m² in Rajasthan is chosen for the technical feasibility of hypothetical CSP plant. The plant design consists of 194 solar collector loops with each loop comprising of 8 parabolic trough collectors. HITEC solar salt is chosen as an HTF due to its excellent thermodynamic properties. The designed plant can generate annual electricity of 285,288,352 kW h with the plant efficiency of 21%. The proposed design of PTC based solar thermal power plant and its performance analysis encourages further innovation and development of solar thermal power plants in India.

1. Introduction

Power generation using solar energy is one of the most promising options for the reduction of fossil fuel consumption and related CO₂ emissions. In India, Solar PV based power generation is given more importance so as to increase the share of electricity production from renewable energy quickly. It is envisaged by Government of India to generate 175 GW electricity from the renewable energy sources by 2022 under Jawaharlal Nehru National Solar Mission [1]. The proposed target is five times the current electricity production from the renewable energy sources. Out of 175 GW target, 100 GW electricity is to be generated from solar energy alone and the remaining will be from the wind, biomass and small hydro. The government of India aims to produce 40 GW from the rooftop solar PV out of total solar-based energy. But this type of power generation is land intensive as well as comparatively low efficient. Till now, India is having an installed capacity of 8.7 GW of solar PV based power plant [1].

Taqiy and Mohamed [2] discussed the Parabolic trough solar thermal power plant: Potential, and projects development in Algeria. The working principles, description of the parabolic trough power plants, and an assessment of concentrating solar power potential in Algeria have been carried out. The analysis shows the competitive viability of CSP plants. Algeria has the key prerequisites to make an economical CSP power generation; including high-quality insolation and appropriate land in addition to water availability and

Abbreviations: SAM, simulation program system advisory model; CSP, concentrated solar thermal power; PTCSTPP, parabolic trough concentrated solar thermal power plant; HTF, heat transfer fluid; DNI, direct normal irradiance

* Corresponding author.

E-mail addresses: deepakbishoyi.re@gmail.com (D. Bishoyi), sudhakar.i@manit.ac.in (K. Sudhakar).

<http://dx.doi.org/10.1016/j.csite.2017.05.005>

Received 16 April 2017; Received in revised form 20 May 2017; Accepted 23 May 2017

Available online 24 May 2017

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