

Tower solar thermal power generation system with dual-stage heat storage and dual operation modes



Overview

A novel tower solar aided coal-fired power generation (TSACPG) system with thermal energy storage is proposed in this paper. Based on the principle of energy grade matching and cascade utilization, the high-temperature solar energy is used to heat the first and second reheat steam extracted from the boiler and the low-temperature solar energy is used to heat the boiler feed water. The maximum steam extraction mass flow rates of the boiler un. A novel tower solar aided coal-fired power generation (TSACPG) system with thermal energy storage is proposed in this paper. Based on the principle of energy grade matching and cascade utilization, the high-temperature solar energy is used to heat the first and second reheat steam extracted from the boiler and the low-temperature solar energy is used to heat the boiler feed water. The maximum steam extraction mass flow rates of the boiler under different load rates are obtained and the thermal performances are also analyzed. The results show that the maximum steam extraction mass flow rates from the first and second reheat part of boiler are 69.7 kg/s and 37 kg/s in 100 %THA (Turbine Heat Acceptance), 78.7 kg/s and 37 kg/s in 90 %THA, 81 kg/s and 31.4 kg/s in 75 %THA, 76.3 kg/s and 31 kg/s in 60 %THA, 68.2 kg/s and 31.2 kg/s in 50 %THA load, respectively. And the standard coal consumption rates can be reduced by 39.85 g/kWh, 39.47 g/kWh, 38.08 g/kWh, 35.50 g/kWh and 35.25 g/kWh, respectively. Both the boiler thermal efficiency and overall thermal efficiency of the TSACPG system descend slightly and the boiler exergy efficiency ascends. With the decline of the load, the solar-to-electricity efficiency, the power output and the proportion of solar power generation descend gradually. And they can reach up to 28.62%, 120.90 MW...

Article Content

A molten salt energy storage integrated with combined heat and power ...

Molten salt- CHP integrated system2.4.1. Dual joint operation mode design. A. ... Energy, exergy, and economic analyses on coal-fired power plants integrated with the power-to-heat thermal energy storage system Energy, 284 (2023 ... A new ultra-flexible coal-fired power generation heat storage semi-tower boiler. CN220793114U [P/OL] (2024 ...

Performance evaluation of a renewable source integrated power ...

A solar-based integrated power generation system (IPGS) converting thermal energy derived from solar fields into electrical power is investigated in this work. The system is designed in such a way that it operates under two distinct modes of operation (charging mode and discharging mode).

Tower type solar energy-based thermal power generation system ...

The authors have presented a tower type of solar energy-based new thermal power generation system with two stages of heat storage and dual operating mode. The ...

Thermal Performance Study of Tower Solar Aided Double

Jiang et al. (2021) proposed a novel tower solar aided coal-fired power generation system with a double reheat ultra-supercritical boiler; the steam in boiler is heated to 565°C under the ...

Thermophysical heat storage for cooling, heating, and power generation ...

Moreover, the specific working principles, developments, and challenges for cooling, heating, and power generation are discussed. Previous article ... and even is close to 1233 MJ•m⁻³ of a dual-reaction system using metal hydride pair ... direct two-tank molten salt thermal storage system for the solar tower plant is a promising ...

Design of steam condensation temperature for an innovative solar ...

An innovative solar thermal power generation system using cascade SORC and two-stage accumulators has recently been proposed. The system offers a significantly higher heat storage capacity than conventional direct steam generation (DSG) solar power plants.

Design, off-design and operation study of concentrating solar power ...

Therefore, at this time, W_{tur} is 0 and W_{net} is negative. when $DNI > 250 \text{ Wm}^{-2}$, the concentrating thermal power is sufficient to drive the power cycle subsystem to run under rated operating conditions, and the remaining concentrating thermal power is used to drive the calcination reaction for energy storage, and the process of energy storage is ...

Life cycle assessment of typical tower solar thermal power station ...

Life cycle assessment of typical tower solar thermal power station in China. Author links open overlay panel Yuchen Yang a, Lin Ma a, ... with the condensing system and heat storage system contributing 50.17 % and 47.64 % respectively. It can be found that the EPT of the CSP-T station is estimated at 4.88 years, accounting for 16.25 % of the ...

Transient performance modelling of solar tower power plants with ...

Concentrating solar power (CSP) has emerged as a dynamic and promising technology, demonstrating a burgeoning market potential for power generation through the utilization of solar thermal resources. Notably, global installed capacity has witnessed a substantial uptick in recent years, indicative that this technology is increasing traction ...

Performance Analysis of Tower Solar Thermal Power System ...

Solar tower thermal power generation technology is promising way to use solar energy to generate electric power. This paper established a system model of a 30 MW tower solar

Performance Analysis of Tower Solar Thermal Power System ...

Performance Analysis of Tower Solar Thermal Power System Wei Wang^{1, a}, Wei Du^{2,b}, Rongrong Zhai ^{3,c*} and Miaomiao Zhao^{4,d} ^{1,2}Nari Group Corporation State Grid Electric Power Research Institute, Nanjing 211000, China ^{3,4}School of Energy, Power and Mechanical Engineering, North China Electric Power University, Beijing 102206, China ...

Two-stage solar power tower cavity-receiver design and thermal ...

New type of two-stage solar power tower cavity-receiver is designed and a calculating procedure of radiation, convection and flow under the Gaussian heat flux is ...

Dual power generation modes for thermally regenerative ...

The paper proposes a novel dual-stroke power system by integrating a CPV/T with TREC and PCM storage to convert the solar and low-grade heat energies to electricity during the day and night. An analytical model is developed and validated to study the efficiency and output power of the CPV/T and TREC under different operating conditions.

Energy and exergy analysis of a new solar hybrid system for ...

This study investigates the amalgamation of solar tower technology and thermal energy storage (TES) within the framework of a supercritical carbon dioxide (S-CO₂) Brayton cycle, a copper-chlorine (Cu-Cl) hydrogen production cycle, and a heat recovery steam generator (HRSG) to generate superheated steam. The various subsystems have been merged to ...

Solar tower power plant optimization: a review

In solar tower power systems with a atmospheric air heat transfer fluid, air enters the receiver from atmosphere without additional pressure, gets hot at the receiver and exits

Performance Analysis of Tower Solar Thermal Power System

DOI: 10.2991/IFEESM-15.2015.151 Corpus ID: 111391618; Performance Analysis of Tower Solar Thermal Power System @inproceedings{Wang2015PerformanceAO, title={Performance Analysis of Tower Solar Thermal Power System}, author={Wei Wang and Wei Du and Rongrong Zhai and Miaomiao Zhao}, year={2015} }

Thermal performance study of tower solar aided double reheat ...

In this paper, a novel tower solar aided coal-fired power generation (TSACPG) system is proposed, which integrates the solar tower with the boiler of a 660 MW double reheat ...

Thermal Performance Study of Tower Solar Aided Double

This paper studies a novel tower solar aided coal-fired power generation (TSACPG) system with thermal energy storage (TES) system to realize the high-grade solar energy cascade utilization and ...

Solar power tower | PPT

The fifth section details of the molten-salt - what is molten-salt and its properties. The sixth section details of components of solar power tower- Heliostat system, receiver system, thermal storage system, steam generator system and electric generation system. In seventh section discuss about advantage of solar power tower.

Solar Power Tower

Solar tower power generation (Fig. 1.8) is a system that transmits solar irradiation to the receiver mounted on the tower and acquires the high-temperature heat transfer medium through multiple heliostats by tracking movement of the sun, generating power directly or indirectly through the thermal cycle using a high-temperature heat transfer ...

(PDF) Solar thermal power generation technology ...

The photo-thermal power generation system consists of four parts: heat collecting system, heat transmission system, heat storage and heat exchange system, and power generation system (see figure 2

Collaborative optimization of thermal and economic performances ...

This paper studies a novel tower solar aided coal-fired power generation (TSACPG) system with thermal energy storage (TES) system to realize the high-grade solar energy cascade utilization and puts forward an improved annual operation strategy of the system. ... Performance of double source boiler with coal-fired and solar power tower heat for ...

Thermal performance study of tower solar aided double reheat ...

In this paper, a novel tower solar aided coal-fired power generation (TSACPG) system with double reheat ultra-supercritical boiler is proposed. Part of the steam at the ...

Annual performance of solar tower aided coal-fired power generation system

Annual DNI and real coal used in STCG are the same to those in Section 4.3.1 Solar tower power generation system, 4.3.2 Coal-fired power generation system. The solar contribution method mentioned in Section 2.3.1 is used to calculate hourly electricity generated by solar thermal energy and coal. After that, the annual electricity generated by ...

CN101413719A

The invention relates to the technical field of solar energy thermal power generation and discloses a tower-typed solar energy thermal power generation system with two-stage...

Solar Tower System

Progress in beam-down solar concentrating systems. Evangelos Bellos, in Progress in Energy and Combustion Science, 2023. 1.1.3 Solar tower. A solar tower (or central system) is a focal point concentrating technology that is used mainly in power production applications with high operating temperature levels is usually applied in applications with relatively high-power ...

Modeling and simulation of a novel combined heat and power system ...

In this paper a novel solar combined heat and power (CHP) system incorporating absorption heat pump (AHP) driven by mid-temperature solar heat and exhaust heat is proposed to improve solar energy utilization and electricity power generation. To validate thermodynamic performance of the proposed system, a case study is carried out based on 1 MW solar tower ...

Solar Heat Storage

Solar Energy Utilization and Its Collection Devices. Hongfei Zheng, in Solar Energy Desalination Technology, 2017. 2.11.4 Heat Storage System of Tower Solar Power Generation. For solar thermal power generation, the functions of a storage system are to adjust loading, reduce the device capacity and investment cost, further improve solar resources and device use ratio, and ...

Thermal performance study of a solar-coupled phase changes thermal ...

Solar power generation has become the main way of renewable energy generation because of its abundant reserves, low cost and clean utilization [1, 2]. Among the technologies related to solar power generation, the reliability and low cost of the organic Rankine cycle (ORC) are widely recognized [3, 4]. The more efficient conventional steam Rankine cycle ...

Thermal energy storage technologies for concentrated solar power ...

Sudhan et al. presented a short review paper, mainly focused on the optimization and design implementation of thermal energy storage and concentrated solar power plants. Boretti et al. , published a review in the present and future status of concentrating solar power tower technology. The authors focused on one CSP configuration, solar ...

Performance analysis of solid heat accumulator used in ...

Tower solar photothermal power generation is a heat absorber that reflects sunlight to the top of the tower through heliostat field. Molten salt absorbs heat through the heat absorber, heats ...

Design and performance analysis of compressed CO₂ energy storage ...

Two kinds of S-CO₂ Brayton cycle tower solar thermal power generation systems using compressed CO₂ energy storage are designed in this paper. The energy storage system uses excess solar energy to compress CO₂ near the critical point to a high-pressure state for energy storage during the day, and the high-pressure CO₂ is heated by a gas-fired boiler ...

Perspective on Dual-Tower Concentrated Solar Power Plants

The power plant features a single molten salt thermal energy storage system, a single power block Rankine cycle, and a single condenser. The innovative layout is anticipated ...

Performance analysis of solid heat accumulator used in tower solar ...

Molten salt absorbs heat through the heat absorber, heats water supply and promotes thermal power generation. However, solar energy is intermittent and unstable, so the tower solar thermal power ...

Collaborative optimization of thermal and economic performances ...

This paper studies a novel tower solar aided coal-fired power generation (TSACPG) system with thermal energy storage (TES) system to realize the high-grade solar energy cascade utilization and ...

Multi-objective optimization of a solar-biomass multi-generation system ...

This arrangement ensures the flexible operation of the hybrid heat generation system, prioritizing solar energy usage. The thermal energy is then transferred from the HTF (stream 5) to the ORC working fluid via a heat transfer system (HTS) comprising three heat exchangers: a preheater, an evaporator, and a superheater.

Design and performance analysis of compressed CO₂ energy storage ...

Two kinds of S-CO₂ Brayton cycle tower solar thermal power generation systems using compressed CO₂ energy storage are designed in this paper. The energy storage system uses excess solar energy to ...

Solar Thermal Power | PPT

7. Thermal energy storage (TES) TES are high-pressure liquid storage tanks used along with a solar thermal system to allow plants to bank several hours of potential electricity. • Two-tank direct system: solar thermal energy is stored right in the same heat-transfer fluid that collected it. • Two-tank indirect system: functions basically the same as the direct ...

Perspective on Dual-Tower Concentrated Solar Power Plants

solar thermal technology. 1 | Introduction Concentrated solar power (CSP) has evolved as a viable solution for large-scale renewable energy generation. The novel dual-tower design at Guazhou, Gansu Province, by Three Gorges Renewables marks a significant milestone in this evolution. This paper discusses the advantages, challenges, and ...

Solar Thermal Power Generation

In central receiver systems and also called as power tower systems, an array of dual-axis tracking-based ... Latent heat storage system stores the heat by changing the phase of material either solid to solid/solid to ...

World's First Dual-Tower Solar Plant Boosts Efficiency by 24%

Ivanpah Solar Electric Generating System. In 2014, the Ivanpah Solar Electric Generating System opened in the Mojave Desert, becoming the world's largest solar thermal power station at the time. Consisting of three towers surrounded by heliostat arrays, it ...

A solar thermal storage power generation system based on lunar ...

The photovoltaic-battery power system and nuclear reactor power battery have been applied in the space exploration [16, 17], but these two power generation systems are facing the launch mass bottleneck for future moon base construction should be noted that the most promising power photovoltaic power system needs specific launch mass at least 7583.3 kg for ...

Unique thermal architecture integrating heliostat solar fields with a ...

Innovative thermal design: The study presents a novel thermal design that harmonizes heliostat solar fields with a dual-loop power generation cycle, seamlessly integrating a system for desalination using RO. This integration is unique in its approach to combining power and water production in a single system.

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