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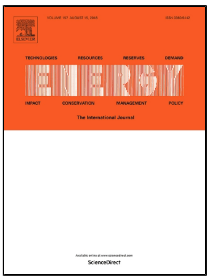

Development and Assessment of Integrating Parabolic Trough Collectors with Gas Turbine Trigeneration System for Producing Electricity, Chilled Water, and Freshwater

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Development and Assessment of Integrating Parabolic Trough Collectors with Gas Turbine Trigeneration System for Producing Electricity, Chilled Water, and Freshwater

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ABSTRACT

The main objective of the present work is to investigate the possible modifications of a gas turbine trigeneration plant via integrating it with a parabolic trough collector (PTC) technology. This plant produces 45461 m^3/day of freshwater and 2300 kg/s of chilled water in addition to producing 360 MWe of electricity (the steam turbines yield 110 MWe). The annual performance of an integrated solar gas turbine trigeneration power plant (ISGTPP) with different sizes of gas turbine and solar collector's area have been examined using Thermoflex software under Al-Hodeidah (Yemen) weather conditions. This study revealed that the ISGTPP results in a minor increase in levelized electricity cost (LEC) compared to the conventional trigeneration plant, nevertheless it reduces the LEC by 62–71.5% relative to the fully-solar-powered PTC power plants. Moreover, the study identified the configuration of ISGTPP with a gas turbine of 130 MWe capacity and 39.7 hectares of PTC's total aperture area as the most optimal engine configuration. It reduces the annual CO_2 emissions by 385 k-tonne (30.2%) in comparing with that emitted by the reference plant with a gas turbine of 250 MWe size and 100 k-tonne (10%) compared with that emitted by the corresponding conventional plant with 130 MWe size.