

Innovative concepts of Integrated Solar Combined Cycles (ISCC) using a Solid Oxide Fuel Cell (SOFC) (118)

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Concentrating solar power is one of the most promising ways for electricity production of the upcoming years with high penetration of intermittent renewable energy sources such as wind and solar-photovoltaics. This is due to the fact that CSP when coupled to thermal energy storage (TES) system enables large, inexpensive and flexible energy dispatch, which contributes to energy grid stabilization. At the same time, TES allows for steady operation of the power block by reducing undesirable fluctuations due to weather transient conditions and increasing the number of hours that the power block operates at design conditions 1. Despite the abovementioned advantages of CSP systems, a step further is needed for increase overall system efficiency and decrease CO₂ emissions (when fuel is consumed to maintain operating conditions of power block). Among different research activities involved seeking for CSP improving power block efficiency is being widely explored. On that frame, several studies have been performed considering high efficiency plant layouts such as combined cycle [1-2]. For the latter, several works have been investigated about solar integration of combined cycle using parabolic trough [3-4] and solar tower [5] technologies. In both cases, solar energy was used for water/steam preheating and evaporation steps of the Rankine cycle in combination with the exhaust gases of fossil-fuel gas turbine engine. However, no research has been performed considering ISCC coupled with a Solid Oxide Fuel Cell (SOFC). In this research, two innovative lay-outs of ISCC power plants will be analyzed. First considers a ISCC based on solar tower, see Figure 1, and second a ISCC with a parabolic trough collector field coupled to the Heat Recovery Steam Generator (HRSG), see Figure 2.

The objective of this research is analyze the energy behavior of both lay-outs, selecting the best ISCC scheme to be coupled with a SOFC. The simulations will be performed using Thermoflex software [6].

In both lay-outs, a SOFC is introduced before the combustion chamber at the topping cycle, and a Rankine cycle (bottoming cycle) with 2 pressures is considered.

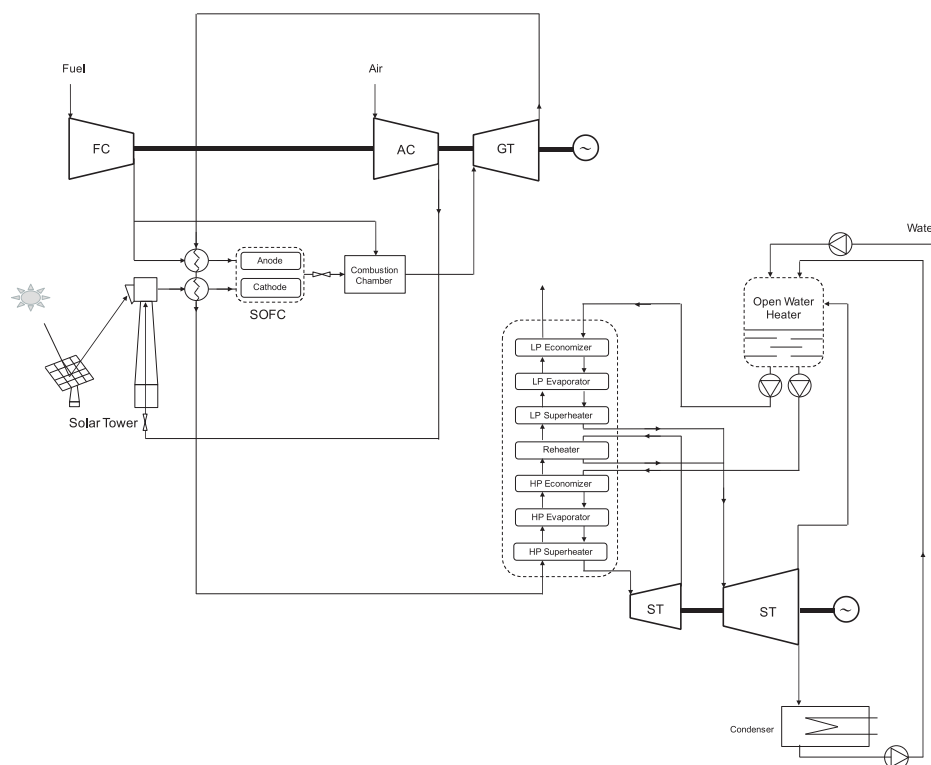


Figure 1. ISCC based on air solar receiver with SOFC integrated in topping cycle.

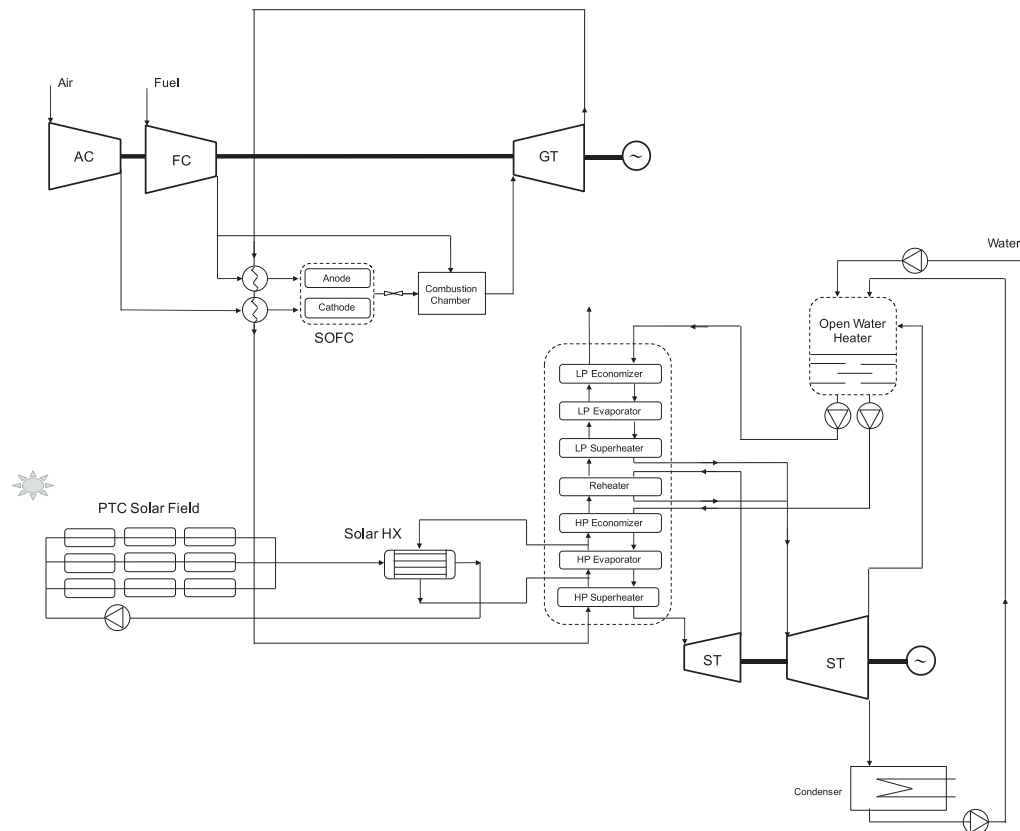


Figure 2. ISCC with Parabolic Through collector field with SOFC integrated in topping cycle.

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