Farkhondeh Jabari, Sayyad Nojavan, Behnam Mohammadi-ivatloo, Hadi Ghaebi and Hasan Mehrjerdi, 2018, Risk-constrained scheduling of solar Stirling engine based industrial continuous heat treatment furnace, *Applied Thermal Engineering,* Vol.128, #5, pp.940–955.

Highlights

- Energy-exergy analysis of a novel soalr Stirling engine based industrial continuous heat treatment furnace is formulated.
- Hybrid solar and wind generations are used as renewables to supply the proposed flame-making process.
- Optimal scheduling strategy of the proposed ICHTF is conducted using IGDT.
- IGDT method with robustness and opportunity functions is used to model the h uncertainty.

Abstract This paper presents a novel framework for designing and optimal scheduling of an air source heat pump based industrial continuous heat treatment furnace (ICHTF) which is driven by a solar Stirling engine and a wind turbine. The proposed flame-making process equipped with two inside and outside fans, an expansion valve, compressor, condenser and an evaporator to supply the heating demand with the high-temperature more than 900 K over a 24-h time interval. Use of solar, wind and the proposed heating cycle in an industrial furnace with no need to fossil fuels reduce the greenhouse gas emissions and increase the economic saving in the consumption of petroleum products, significantly. Moreover, an information gap decision theory (IGDT) is implemented in order to find the optimal scheduling strategies taking into account the heating demand uncertainty. The IGDT technique assesses the robustness and opportunistic aspects of the optimal scheduling scenarios in the presence of heating load uncertainty to make the risk-averse or risk-taker decisions, respectively. The proposed ICHTF is simulated as a nonlinear programming (NLP) problem on a benchmark small-scale industrial sector to minimize total energy procurement cost considering the operational constraints of Stirling cycle and air source heat pump. Simulation results confirm that the risk-aversion or risk-taking decisions affect the output mechanical power of Stirling engine and total electrical power purchased from the upstream grid.

Keywords Flame-making process, Industrial continuous heat treatment furnace (ICHTF), Solar Stirling engine, Information gap decision theory (IGDT)