Thermo-economic comparison of air-cooled and cooling tower based Organic Rankine Cycle (ORC) with R245fa and R1233zdde as candidate working fluids for different geographical climate conditions - DTU Orbit (27/12/2018)

Thermo-economic comparison of air-cooled and cooling tower based Organic Rankine Cycle (ORC) with R245fa and R1233zdde as candidate working fluids for different geographical climate conditions

This article compares the part-load operation of air cooled and cooling tower based low-medium temperature geothermal Organic Rankine Cycle (ORC) systems installed at different geographical locations. Working fluid R245fa was compared with a newer competitor R1233zdde for thermo-economic performance, environment-friendly and efficient system integration. Monthly averaged, weather data is used to simulate ambient conditions of Ulsan, London, Vegas and Kuala Lumpur. Mathematical models for condenser part load operation were formulated for both air cooled and mechanical draft wet cooling tower based systems. Numerical study and experimental validation was performed for the condenser when wet cooling tower based system was investigated. The ORC system design was optimized for maximum power output to grid and operational control optimization was performed on the heat sink to achieve maximum power output at different ambient or off-design conditions. Economic analysis was performed by comparing the capital investment/kW and levelized cost of electricity (LCOE) over the lifetime of the system. Based on the economic analysis, the results reveal that R1233zdde has potential to replace R245fa working fluid when the source temperature is higher (around 145 degrees C). Cooling tower based system are preferable for hot dry regions while air-cooled systems can be implemented with R1233zdde for Ulsan and London. (C) 2017 Elsevier Ltd. All rights reserved.

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