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Design and Analysis of a Combined Cooling, Heating and Power Plant for Maximum Operational Flexibility

Authors : Salah Hosseini, Hadi Ramezani, Bagher Shahbazi, Hossein Rabiei, Jafar Hooshmand, Hiwa Khaldi

Abstract : Diversity of energy portfolio and fluctuation of urban energy demand establish the need for more operational flexibility of combined Cooling, Heat, and Power Plants. Currently, the most common way to achieve these specifications is the use of heat storage devices or wet operation of gas turbines. The current work addresses using variable extraction steam turbine in conjugation with a gas turbine inlet cooling system as an alternative way for enhancement of a CCHP cycle operating range. A thermodynamic model is developed and typical apartments building in PARDIS Technology Park (located at Tehran Province) is chosen as a case study. Due to the variable Heat demand and using excess chiller capacity for turbine inlet cooling purpose, the mentioned steam turbine and TIAC system provided an opportunity for flexible operation of the cycle and boosted the independence of the power and heat generation in the CCHP plant. It was found that the ratio of power to the heat of CCHP cycle varies from 12.6 to 2.4 depending on the City heating and cooling demands and ambient condition, which means a good independence between power and heat generation. Furthermore, selection of the TIAC design temperature is done based on the amount of ratio of power gain to TIAC coil surface area, it was found that for current cycle arrangement the TIAC design temperature of 15 C is most economical. All analysis is done based on the real data, gathered from the local weather station of the PARDIS site.

Keywords : CCHP plant, GTG, HRSG, STG, TIAC, operational flexibility, power to heat ratio
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