Simultaneous use of MRM and optimization methods in determining nominal capacity of gas engines in CCHP systems

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Abstract

Energy, economic, and environmental analyses of combined cooling, heating and power (CCHP) systems were performed here to select the nominal capacities of gas engines by combination of optimization algorithm and maximum rectangle method (MRM). The analysis was performed for both priority of providing electricity (PE) and priority of providing heat (PH) operation strategies. Four scenarios (SELL-PE, SELL-PH, No SELL-PE, No SELL-PH) were followed to specify design parameters such as the number and nominal power of prime movers, heating capacities of both backup boiler and energy storage tank, and the cooling capacities of electrical and absorption chillers. By defining an objective function called the Relative Annual Benefit (RAB), Genetic Algorithm optimization method was used for finding the optimal values of design parameters. The optimization results indicated that two gas engines (with nominal powers of 3780 and 3930 kW) in SELL-PE scenario, two gas engines (with nominal powers of 5290 and 5300 kW) in SELL-PH scenario, one gas engine (with nominal power of 2440 kW) in No SELL-PE scenario provided the maximum value of the objective function. Furthermore in No SELL-PE scenario (which had the lowest RAB value in comparison with that for the above mentioned scenarios), thermal energy storage was not required. Due to very low value of RAB, any gas engine in No SELL-PH scenario was not recommended.

Keywords: Combined Cooling, Heating and Power (CCHP), Genetic Algorithm (GA), Relative Annual Benefit (RAB), Maximum Rectangle Method (MRM).

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