Economic and Environmental Based Operation Strategies of A Hybrid Photovoltaic–Microgas Turbine Trigeneration System

Firdaus Basrawi[a], Takanobu Yamada[b], Shin'ya Obara[c],

[a] Universiti Malaysia Pahang, Faculty of Mechanical Engineering, 26600 Pekan, Pahang, Malaysia

[b] Kitami Institute of Technology, Department of Mechanical Engineering, 165, Koen-Cho, Kitami City, Hokkaido 090-8507, Japan

[c] Kitami Institute of Technology, Department of Electrical and Electronic Engineering, 165, Koen-Cho, Kitami City, Hokkaido 090-8507, Japan

ABSTRACT

This study investigates the economic and environmental performance of a photovoltaic (PV) and microgas turbine trigeneration system (MGT-TGS) based hybrid energy system with various operation strategies. The hybrid system covers power, heating and cooling load of a selected building under a tropical region. A case of MGT-TGS without PV was also studied for comparison. Each system had an MGT with electrical output capacity of 30 kW or 65 kW as the core prime mover. Economic performance was analyzed using life cycle cost analysis and environmental performance was analyzed based on the actual emissions of MGT reported in literatures. It was found that all operation strategies can only generate Net Profit when subsidy for electricity was eliminated. Combination of photovoltaic and MGT-TGS with power-match operation strategy had the highest Net Profit and was the simplest hybrid system. This was mainly because this system did not require battery that has high cost. However, this system had low environmental performance especially when they are compared to a combined cycle gas turbine (CCGT) because larger MGTs in this system operated frequently under partial load. Operation strategy that had smaller MGT that operated under full load can still generate Net Profit but at lower degree because it needs larger PV and battery. However, it was the only operation strategy that can reduce all emissions even when compared to a CCGT. Thus, this is the best operation strategy when economic and environmental performance are fairly considered.

KEYWORDS: Microgas turbine; Trigeneration system; Photovoltaic; Emissions; Economic; Hybrid energy system

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