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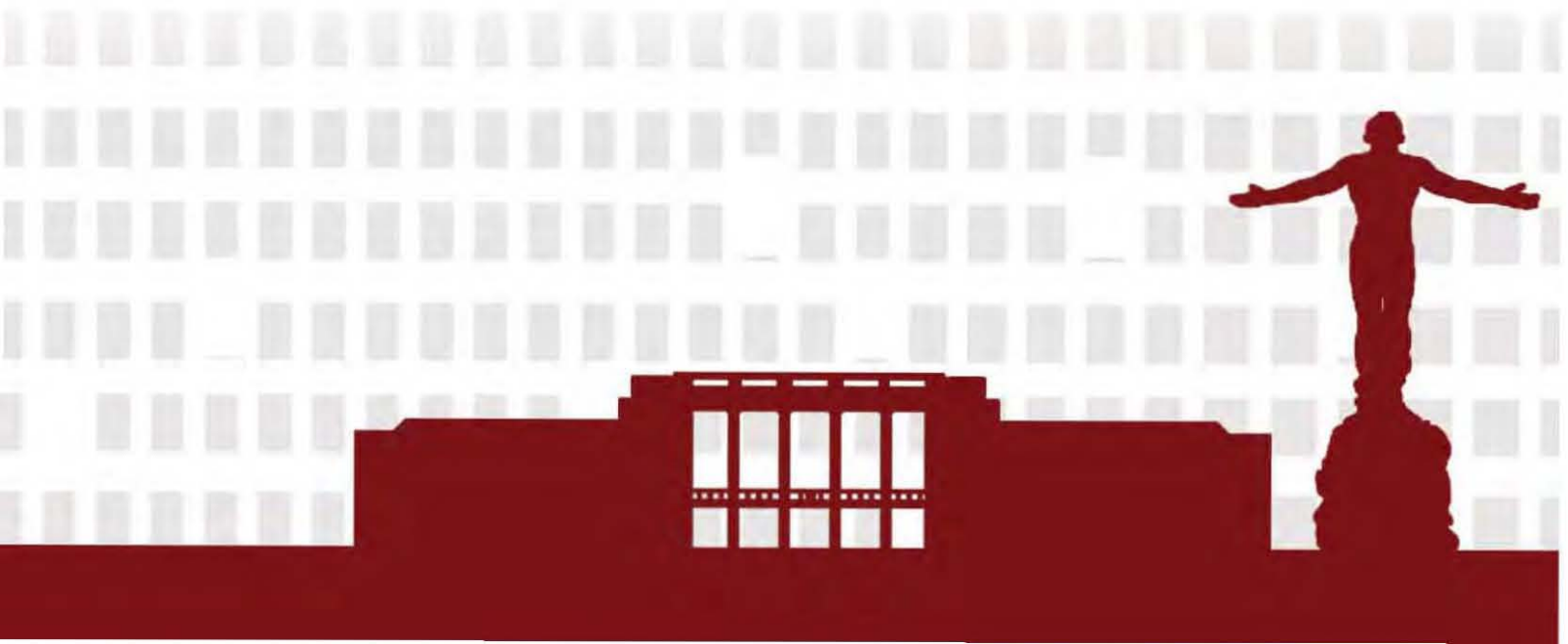

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DETERMINATION OF OPTIMAL SIZING FOR ENERGY STORAGE IN A HYBRID WIND-DIESEL ENERGY SYSTEM

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ABSTRACT

Diesel generator sets is a very popular solution to provide electrical energy for rural and isolated communities. Nowadays, wind energy has become a very viable alternative solution to provide electrical energy to these communities. This is especially relevant for the case of isolated island in the south central provinces of Vietnam, where there is great potential for wind energy. The co-generation of diesel generators and wind turbines posed several technical challenges. In fact, auxiliary equipments, such as battery storage, flywheel and dump loads are often needed to ensure a more stable operation, higher penetration level of wind energy [1,2,4]. However, the cost for these auxiliary equipment can be substantial. Therefore a thorough analysis of economic aspect of wind-diesel hybrid system with integration of battery storage, dump load and other equipment is necessary.

This paper presents the study results for an actual case: the wind-diesel hybrid system in the Phu Quy island, Binh Thuan province, Vietnam. The system consists of 6 diesel generators with rated power of 500kW, and 3 wind turbines with rated power of 2 MW. Since the wind farm capacity is large compared to that of diesel generators, auxiliary solutions such as battery storage and dump loads are considered to maximize the penetration level of the wind farm.

To determine the optimal power rating for the energy storage, and its inverter, a stochastic optimization model has been formulated. In the case of battery energy storage, the main objective function of the optimization is shown below [1]:
where:

K_E:	Cost of installation of battery storage ($/kWh)
E_{ESS}:	Capacity of the battery storage (kWh)
K_P	Cost for installing the inverter of the battery storage ($/kW)
P_{ESS}	Rated power of the inverter (kW)
π_e:	Price of electrical energy produced from diesel ($/kWh)
π_{Oil} :	Diesel fuel cost.
π_w:	Price of electrical energy produced by wind farm (regulated by Feed-in Tariff)

$P_{(DG,t)}$ và $P_{(w,t)}$ are the power output of diesel generators and wind farm at time *t*.
z is an operator indicating the scenarios considered.

The study is carried out using actual system data. The wind speed distribution data is collected from field measurement [3]. Since load growth constitutes a substantial uncertain factor in the study, the optimization problem is solved with several assumption of load growth factor. Typical result of this study is shown in the figure 1 below. The optimization framework is also extended to consider dump loads and low load diesel generators [4].

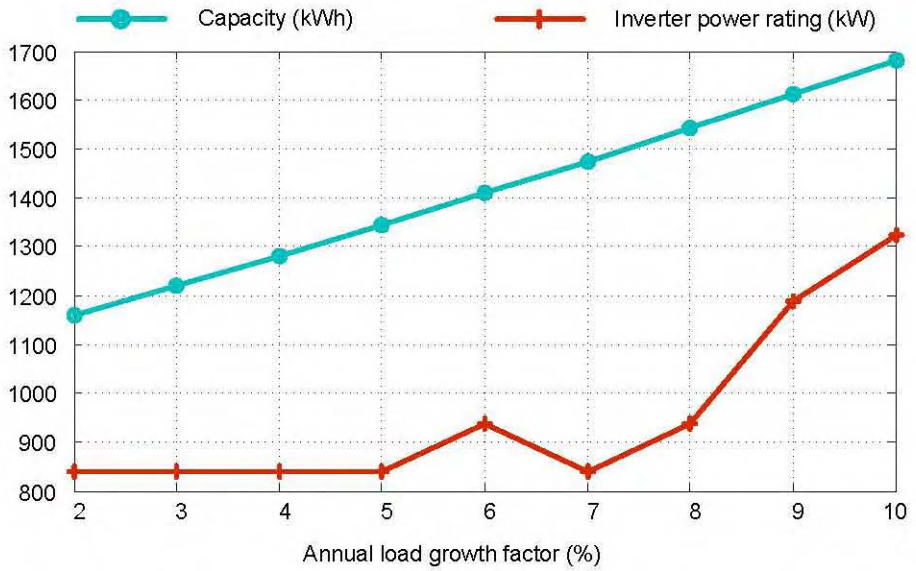

Figure 1. Storage capacity and rated power for the inverter with different load growth factors.

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