Proceedings of 27th Annual Technological Advances in Science, Medicine and Engineering Conference 2023

An Ex-Post Review of Control Approach And Performance of Hybrid Power System in Eluvaithivu Island

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Abstract

Renewable energy based hybrid electricity supply is very essential to power supply to remote areas. Eluvaithivu is a one of remote islands of Sri Lanka located in Northern Province. It is 3.3 km far from the mainland of Jaffna. Supplying the electricity from national grid is inefficient and it requests a higher cost. Accordingly, a hybrid power system which is proposed based on the Microgrid concept is implemented in this island in 2015.

This existing electricity hybrid power system in Eluvaithivu is a combination of solar PV system (21 kW), wind turbine (46 kW), battery storage (135 kWh) and a diesel generator (30 kW). In addition to that it also has two external diesel generators which has 80 kW and 100 kW capacity in each. It has been identified that the hybrid operation of this system is not efficient as the diesel generators are supplying the energy to the demand in most of the occasions. Considering the Cost of Energy (COE) and the high carbon emission it has a negative impact to the utility and also to the environment.

Though the COE is high CEB sells the electricity unit to the consumers according to normal electricity tariff. It has been estimated that the average production cost of one unit (1 kWh) is 70 LKR but the selling price of a unit is according to the normal tariff system. Financially this electricity supply made minus income to the CEB.

This research work is carried out to find the reason for the high consumption of diesel to supply the demand and to propose a new control approach based on the system modelling and simulations results. This research analyses the system in three steps.

In 1st step the existing system economical and technical data are collected and analyzed by manual calculations. As the 2nd step the existing system is modeled in HOMER PRO simulation software. It has been identified with the simulation results that unsuitable capacity of the diesel generators, less capacity of battery storage and low renewable energy penetration are the reason for high usage of diesel generator. As the 3rd step a new model was propose and modelled in HOMER PRO. The new system contains of 35 kW diesel generator,103 kW PV system, 21 kW wind turbines and 291 kWh battery storage. The results show that the usage of the diesel fuel is reduced from 23819 liters per annum to 5717 liters per annum with the proposed model.

Last modified: 2023-06-17

Building: SickKids Hospital / University of Toronto
Room: Science Hall
Date: July 1, 2023 - 11:20 AM – 11:35 AM

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