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Title of Speech:

Multifunctional Grid-Integrated Energy Storage as an Innovative Solution to Supply Electricity Cheaply, Effectively and Reliably under Renewable Energy and Flexible Loads

Abstract:

The Malaysian government has launched a number of initiatives to encourage the utilisation of renewable energy in order to reduce greenhouse gas emission in addressing climate change issues. Feed-in-tariffs, tax exemptions, incentives and subsidies for renewable energy installation are among the remunerative packages. Photovoltaic system is the most encouraging renewable energy source in Malaysia because of the large amount of sunlight throughout the year. Therefore, the amount of PV on the low-voltage distribution networks is growing very rapidly. However, most PV system installations are driven by customers and are not centrally planned. As a result, a large number of PV systems can cause power quality issues such as voltage rise, voltage unbalance, unnecessary neutral current circulation and reverse power flow, which affect the reliability of power supply, efficiency of electric network and customers' equipment. Furthermore, the voltage issues are dynamic in Malaysia due to the large amount of passing clouds over the PV panels. Therefore, characteristics, such as severity, types and the frequency of voltage issues, were studied experimentally to address the above issues. A novel fuzzy controlled energy storage system is developed and verified experimentally. This method is more capable than the existing methods, because it can solve dynamic voltage issues more effectively. As a result, the amount of PV systems on the networks will be optimised without any constraint. Hence, the government can reduce the greenhouse gas emissions and minimise the climate change issues. This kind of solution is often sought after by many countries who

suffer highly intermittent PV power outputs that limit the amount of PV systems on their distribution networks. With this solution, the amount of the PV systems can be doubled on the distribution networks. The amount of greenhouse gas emission can be further reduced. This research project is funded by the Ministry of Energy, Green Technology and Water (KeTTHA).

Industrial and commercial customers are subject to the maximum demand charges in addition to the monthly electricity (kWh) being consumed. The maximum demand charges can be as high as 40 % of the total electricity bills. One of the possible solutions for reducing the maximum demand charges is to use a large-scaled energy storage system to discharge the power during peak hours and charge the batteries during off-peak hours. Therefore, a 400 kW and 780 kWh energy storage system has been constructed and connected to 11 kV network via a 500 kVA transformer at the campus for the purpose of reducing the peak demands at the university building. The energy storage system is used to supply power to the building during peak hours and then charge the batteries during off peak hours. This large-scaled energy storage system is carried out with the support of TNB. An innovative control algorithm has been developed to control the charging strategies of the batteries such that the daily peak demands can be effectively reduced. This energy storage system with its innovative controller is the only kind in South East Asia at present. This project is carried out in collaboration with Newcastle University in the UK and University of Applied Science in West Coast in Germany. This research project is financially supported by the Ministry of Energy, Green Technology and Water (KeTTHA) as well as Newton Fund from the British Council.