UNIVERSITI TEKNOLOGI MARA

INTEGRATION OF PV AND ENERGY EFFICIENT TECHNOLOGY FOR UNBALANCED LOADS IN BUILDINGS

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Customarily, photovoltaic (PV) solar systems are largely installed as the alternative to conventional Generation due to growing awareness of carbon emission, fuel scarcity and global warming suppling the energy. the number of PV solar installation is growing rapidly as this technology can provide a significant share of electricity demand. As the energy efficiency building system also part of the improvement to reduce the energy consumption where the shunt capacitors are commonly used in electrical distribution networks to compensate for reactive power, which reduces power losses, improves voltage profiles, and free up feeder capacity. This spurs into an idea of integrated PV solar system with energy efficiency and energy saving improvement for an unbalanced electrical system in a large-scale building. The energy efficiency is obtained by minimising power losses using the Volt-VAR optimization approach. However, in a large-scale building with an unbalanced electrical system, finding the ideal location and sizing of voltage regulators and capacitors is a difficult and complex combinatorial optimization problem. This thesis combines an integrated PV solar system with a detailed analysis of the energy efficiency using Volt-Var optimization in an imbalanced electrical system for a large-scale building to find the best position and sizing for voltage regulators and capacitors which will resulting in energy savings, reduced power losses, and a lower total investment cost for the installed equipment. Furthermore, the total cost of energy consumption, total cost of power losses, voltage regulator, and capacitor installation costs are all considered in the objective function in the proposed optimization techniques. In this study, the optimization technique, PSO are developed in the MATLAB® will transfer the optimal sizing and placement of voltage regulators and capacitors to the SIMULINK® software. Simultaneously, the SIMULINK® software will analyse the load flow solution for a large-scale building's unbalanced electrical system and pass the results to the MATLAB® software for more detailed analysis. At the same time, SIMULINK® will execute the PV solar system circuit that integrate with the large-scale building's that had been optimised sizing and positioning of voltage regulators and capacitors. Both the PV solar system circuit and large-scale building's unbalanced electrical system circuit are design with SIMULINK® software. The results have shown that the OPS-VRC method based PSO integrated with PV solar system provides a propitious amount of energy saving as the PV solar system acting as supporting energy to the system. The result also shown some fluctuation in power factor, voltage magnitude as well as total harmonic distortion but without violating the limit specified by the utility. Further comparison in the performance of PV solar system integration with OPS-VRC based PSO is performed with the PV solar system integration with optimized large-scale building's unbalanced electrical system and also compared with the optimized sizing and positioning of voltage regulators subsequent to capacitors (OPS-VRC) in order to verify effectiveness of the proposed methodology in providing PV solar energy with combination of energy efficiency improvement for a large-scale building.

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