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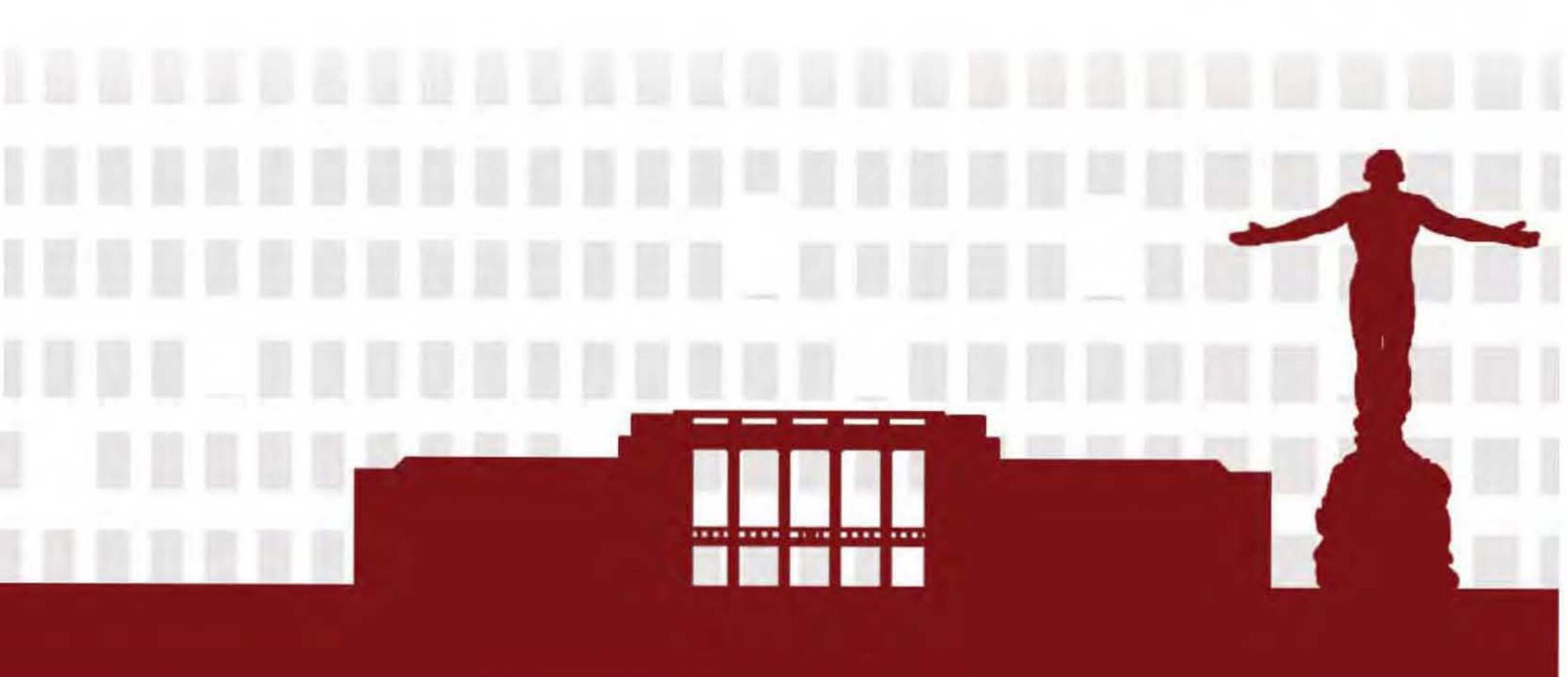

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COMPARATIVE ANALYSIS OF DIFFERENT MODELING APPROACHES IN THE OPTIMAL ALLOCATION OF EMBEDDED GENERATOR

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ABSTRACT

Currently in the context of optimal allocation of embedded generator (EG) in the distribution utility, there are no existing methods that simultaneously consider the type of load, and the inherent time-varying behavior of the demand and generation. Previous study [1] has shown that optimal allocation of EG resources in distribution systems can be greatly affected by load models. On the other hand, misleading results in the optimal allocation of EG might occur if only the peak demand or critical scenarios of loading and generation is considered due to the overestimation of the advantages produced by the integration of EG in the distribution network [2]. In particular, the study considering only peak analysis produces different results from the study able to evaluate every demand scenario [3]. Thus, the exclusion of the types of loads and time-varying characteristics of the demand and generator in the allocation of EG may lead to sub-optimal decisions. In order to address this problem, it is necessary to determine the optimal allocation of EG that considers both the types of loads and the time-varying characteristics of the demand and generation.

The study is made on the basis of minimizing power losses and improvement in the voltage profile of the system. A combination of simplified stochastic load flow simulation and genetic algorithm is utilized in the analysis. Genetic algorithm (GA) is used to determine the optimal allocation of the EG. A simplified stochastic load flow simulation-based approach is utilized to consider the power output of photovoltaic and wind generator models and the time-varying behavior of the demand. The loads considered are purely residential, purely industrial and purely commercial models. The study was implemented in IEEE 37-bus test system using MATLAB.

The developed methodology has the capability of comparing four (4) different modeling approaches in optimal EG allocation. These modeling approaches include voltage-invariant load model without temporal variation, voltage-dependent load model without temporal variation, voltage-invariant load model with temporal variation and voltage-dependent load model with temporal variation. The following figures show the comparison of the computed power losses if no EG is present in the system.

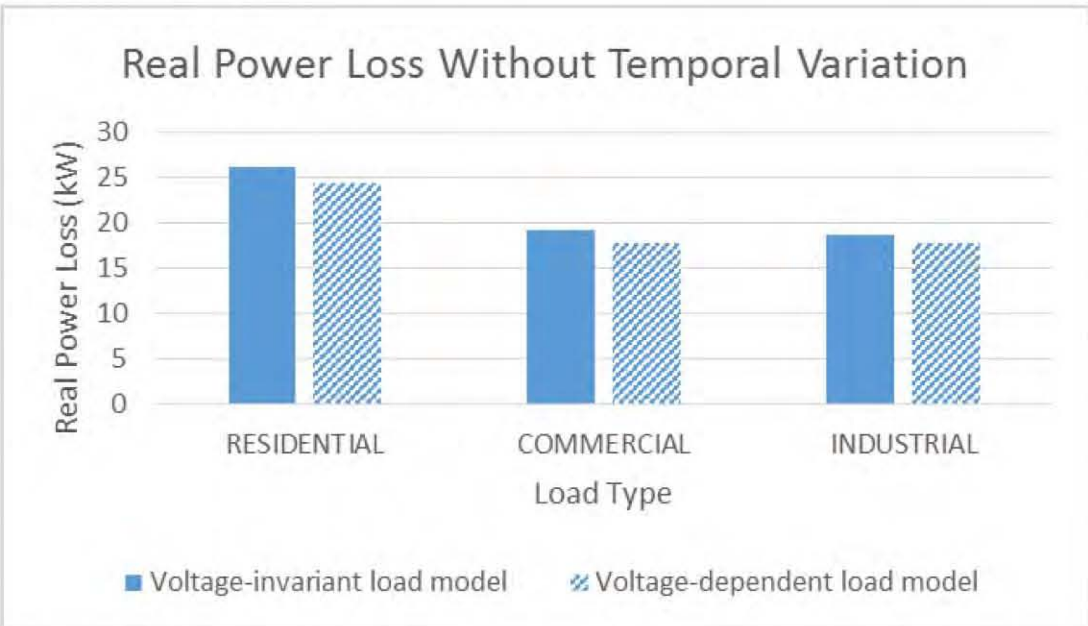

Figure 1. Comparison of Real Power Loss without Temporal Variation.

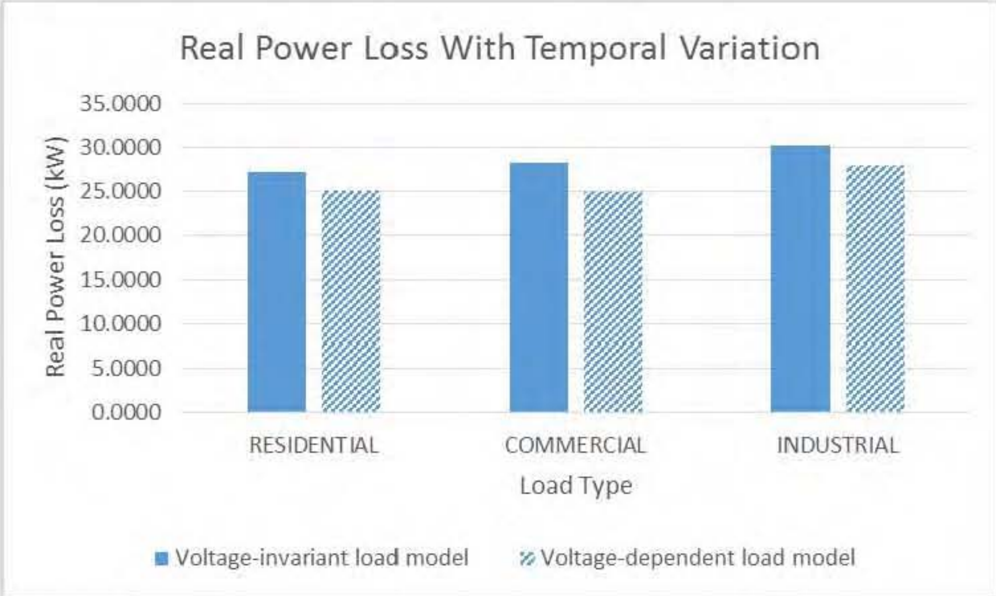

Figure 2. Comparison of Real Power Loss with Temporal Variation.

It can be seen in the results that the voltage-invariant model yields higher total computed power loss compared to voltage-dependent load model. Moreover, results considering voltage-dependent load model with temporal variation modeling approach showed that the computed power loss may differ by as much as 13% if voltage- and time-invariant models are used.

Keywords: Embedded Generator, Genetic Algorithm, Load Model, Optimal Allocation, Power Loss, Voltage Improvement.

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