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ANALYSIS OF INTERCONNECTED POWER SYSTEMS BY HYBRID CALCULATION

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Abstract Distributed Energy Resources (DERs) are being added to the existing power supply systems to compensate for the growing electricity demand. This results in new power supply systems such as mini-grids and micro-grids being implemented into existing grids. In order to manage and optimize the operation of these new systems, power system analysis is utilized. However, the analysis model structure has to be recreated, once a new system joins the existing system. This results in an increased complexity of power system analysis, which calls for its simplification. The objective of this paper is to present a power system analysis method, which does not require restructuring of the analysis model in order to simplify the analysis of interconnected power systems. Hybrid calculation is applied in order to analyze the grid connecting points. This results the proposed analysis method can be performed by exchanging several parameters between the grid connecting points. The simulation results of the proposed method are compared with the general analysis in order to provide proof that the proposed method can be utilized as the general analysis method.

Keywords
Power system analysis, Interconnected power systems, Hybrid calculation, Dynamic-RMS model

1. Introduction

As the electricity demand is continuously increasing and the energy market expanding, DERs are quickly penetrating the market and being integrated into existing power systems. These form new power supply systems such as local distribution grids, mini-grids and micro-grids. These can serve as electricity providers to power systems or to consumers from other generation resources. The cooperation between several new grids with the existing grid is necessary in order to manage, plan and optimize the power system, and avoid overloading of existing system components, when a new grid is added. Therefore, power system analysis is necessary to fulfill those requirements. Fig. 1 portrays a new grid joining an existing grid.

In general, the analysis of power systems uses a bus admittance matrix in order to define a system structure. If this bus admittance matrix is to be used when a new grid joins an existing grid, the consequence is a complex analysis, due to the complete recreation of the bus admittance matrix for the new system. This reduces the flexibility of the analysis and its ability to support the new grid. This is the reason why the analysis method has to be adapted from the general analysis methods. This paper proposes a method to analyze the power system without the need to recreate the new bus admittance matrix, when a new grid joins an existing one.

In order to prove the proposed analysis method, the simulated power system needs a generation component, which provides a system frequency, terminal voltage and generates electrical power to support load demand. A diesel generator is one of the several generator components, which provides those requirements to the system, and is therefore used for the simulation case studies in this paper. However, the simulation of the full dynamic behavior of diesel generators is a time-consuming process in complex systems. Thus, the dynamic-RMS model (see more details in [1]-[5]) is introduced, bringing with it further advantages. It reduces the computing time, which leads to a fast simulation of the complex power system, and uses less computational resources, while achieving the same behavior and almost similar results compared to a full scale dynamic model.

This paper is structured as follows: In chapter two, a general description of power system structure is given in order to define the bus admittance matrix. Chapter three clarifies the proposed interconnected power system analysis method. Moreover, the necessary exchange parameters between interconnected grids are introduced.

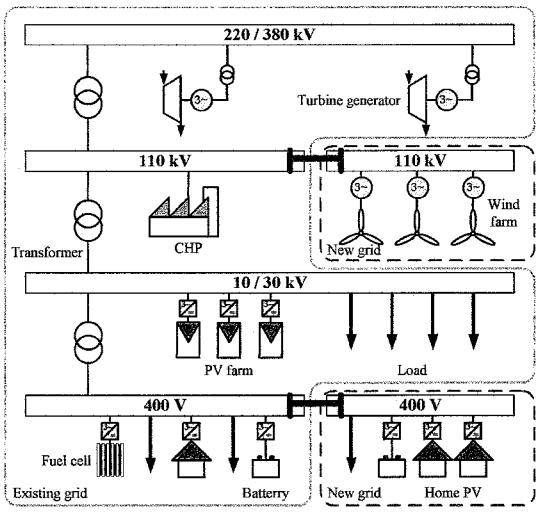

Fig.1. New grid joins the existing grid