# 分散型電源の大量導入を考慮したスマートグリッド送電システムにおける可制御負荷の応用

Form 3

## Abstract

Title A Study on the Application of Controllable Loads in Smart-grid Transmission Systems Considering High Distributed Generator Penetration
(分散型電源の大量導入を考慮したスマートグリッド送電システムにおける可制御負荷の応用)


There has been a recent trend in modern power systems aimed at the incorporation of increasingly larger penetration from power generators utilizing renewable energy. The main renewable energy agents are increasingly large scale "power farms" using solar and wind energy to generate power. Furthermore, the power sector has also begun allowing residents and homeowners to benefit from privately owned photovoltaic generators via feed-in tariffs.

Though many benefits come from utilizing renewable energy, these distributed generators heavily rely on the weather, and thus provide unpredictable fluctuating power. Combined with an unpredictable load, this causes fluctuations in bus voltages and variations in the system frequency. The main generators use more fuel to compensate for the fluctuations, and this causes an increase in the price of electricity. Voltage fluctuations can lead to instabilities, and if the loads are near the transmission limits the possibility of a voltage collapse increases. Thus, it is very important to control the system frequency and bus voltages in the power system.

The present Doctoral dissertation seeks to present control methodologies for controllable loads (CLs) within distribution systems, utilizing a smart grid demand-response type of approach in order to suppress fluctuations in bus voltage and system frequency within large multi-generator power transmission systems. The control methodologies have been tailored to specific promising technologies, which allow large-scale effects on the demand side without diminishing the comfort of residents who use the technologies.

The control methodologies utilized in this dissertation allow the demand-response autonomously, without necessitating communications with a centralized controller. The benefit of this method is that complex communication or security measures will not be needed to allow full-scale implementation. Using control methodologies such as fuzzy control, droop control, probabilistic decentralized control, and structured $H_\infty$ feedback control with these CLs, suppression of frequency and voltage fluctuations has been accomplished while allowing greater amounts of distributed power to be injected into the system.



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