Improved Control Strategy of a V2G Micro-Grid for Transient Stability Enhancement

BY

HAJI AHMED

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SUPERVISED BY

DR. ASAD WAQAR

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CERTIFICATE

We accept the work contained in this report as a confirmation to the required standard for the partial fulfillment of the degree of MS(EE).

Head of Department

Supervisor

Internal Examiner

External Examiner

DEDICATION

I dedicate this small PIece of the effort to my parents & supervisor as well as my colleagues, who encouraged and supported me during the whole tenure. Without their support and sincere advise, it could not possible to complete within a given time period.

DECLARATION OF AUTHORSHIP

I hereby declare that the content of this thesis is my own work and that it is the result of work done during the period of registration. To the best of my knowledge, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or another institute of higher learning, except where due acknowledgment has been made in the text.

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(Student Signature)

Haji Ahmed

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ABSTRWORK

The power system is a very complex and sensitive to sudden change in load, line tripPIng, generator problem and islanding of grid. These conditions create voltage, current and frequency transients on the utility grid. The second issue is the overloading of the distribution system in which the distribution system is overstressed and increase the losses of the distribution lines and distribution transformer. In these situations, the protection system will operate and continuity of the service will disturb the distribution system due to load shedding. According to these difficulties, the stability and service continuity of the distribution system is a challenging task.

In this research, Electric Vehicles batteries are used for overcoming the discontinuity of service, overloading and transient conditions of the distribution system due to their raPId response, efficient control and minimum cost. In this research, introduce a two-way power deliver in which the regulation of charging and discharging of electric vehicle batteries has been introduced to overcome the overloading, line tripPIng and transient conditions of the distribution system. When power will deliver from utility grid to electric vehicle batteries then the charging current of electric vehicle batteries will be controlled according to the distribution load and protect the distribution transformer and distribution lines to overloading. When the secondary load of the distribution transformer will increase the charging current of the electric vehicle batteries will be decreased by using the charging station controller and protect the distribution transformer to overloading. When the load on the secondary side of the distribution transformer will increase more than the charging current of the electric vehicle batteries will be zero and battery charging will be stopped. When the load on the secondary side of the distribution transformer will increase to a specific limit then electric vehicle batteries will start to discharging and provide the power to distribution loads and protect the distribution transformer and distribution lines to overloading without load shedding. When the secondary load of the distribution transformer will decrease, the batteries charging current will increase again and Electric Vehicle Batteries charge to its full rating.

When the abnormal condition occurs on the utility grid. Utility grid switch to islanding mode then Electric vehicle batteries behave as a distributed energy source and deliver the power to the grid and increase the stability of the utility grid in islanding condition. In both overloading and islanding conditions, the charging and discharging of electric vehicle batteries will be controlled and protect the distribution system to overloading and transients without any extra expense.

For this purpose, PI controllers, Fuzzy logic controllers, and Fuzzy logic-based PI controller are used to improve the stability of the grid network during overloading and transient response using V2G. This overall situation is simulated in MATLAB/SIMULINK and tested on reference distribution systems. Experimental outcomes illustrate that the proposed controllers successfully stabilize the grid during overloading and transients.

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ABBREVIATIONS

VSC: Voltage Source Converter

G2V: Grid to Vehicle

V2G: Vehicle to Grid

D-STATCOM: Distributed Static Compensator

PI: Proportional Integrator

EVs: Electric Vehicles

SOC: State of charge