

Comparative Analysis of Vehicle-to-Grid Systems: Grid-Connected and Isolated Configurations

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ABSTRACT

Today is a renewable energy generation based era. In accordance with the efforts to reduce CO₂ emission and reduce the dependence on fossil fuels for energy generation, a variety of renewable energy resources are penetrating more into the power grid. Almost more than 60% of the world's oil productions are consumed by vehicles on roads. Gas driven internal combustion engines are low efficiency systems that emit several harmful gases and establish an unsustainable and inefficient transportation system. These are harmful effect reduced by energy generation by renewable energy source and using electrical vehicle in transportation. In a study, it is reported that vehicles are responsible for 30% of the world total energy consumptions and 27% of total greenhouse gas emissions. Hence, to eliminate emissions originated from urban life, grid-connected vehicles have been recognized as one of the effective option. These are harmful effect reduced by energy generation by renewable energy source and using electrical vehicle in transportation. In this study two V2G case are considered, first without utility grid connected V2G system and secondly utility grid connected V2G system and it is observed that, the transient effect of all parameters are reduced, and performance of V2G system are improved. Hence stability of V2G system by using utility grid gets improved.

Keywords: Smart grid, vehicle-to-grid system (V2G), utility grid, electric vehicle

INTRODUCTION

Vehicle-to-Grid (V2G) networks are important components of smart grid (SG), which provide charging service for largescale plug-in electric vehicles (PEVs) and make vehicles as mobile and distributed storage unit accessing to smart grid.[4,5] For assuring reliable and efficient ancillary services to the power grid, the operator of V2G network need to monitor the up-to-date status of every individual PEVs and evaluate the total current electricity storage capability available. Since the status includes some

close monitoring tends to raise privacy concerns from the PEV owners about their identities and other relevant information leakage. In addition, the authentication protocol is an indispensable part for V2G networks to ensure only the eligible PEV could access the V2G networks. Therefore, an effective and privacy-preserving authentication scheme is highly needed for V2G networks to keep confidential for user privacy.

An electric vehicle (EV) has a battery pack connected to an electric motor and provides traction power by using transmission. The

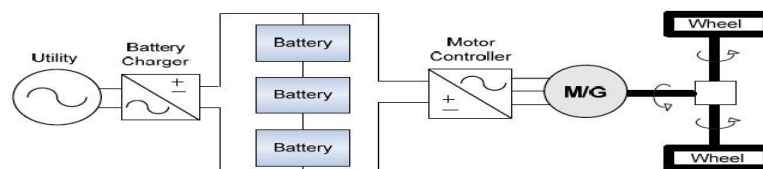


Fig. 1: Electric Vehicle.

sensitive information, such as PEV's location, trip data, payment information, battery state, and user preference, etc., the

batteries are charged primarily by a battery charger that receives its power from external source vehicles, such as the

electrical utility. Also during regenerative braking, the motor acts as a generator and provides power back to the batteries and also in the process slows down the vehicle. The primary advantage of an EV is that the design is simple and has a low part count. The primary disadvantage of it is that the driving range of the vehicle is limited to the size of the battery and the time to re-charge the battery can be from 15 minutes to 8 hours depending on how far the vehicle was last driven, the battery type and charging method.

LITERATURE SURVEY

Rizvi *et al* 2018[9], has studied about V2G system under the topic, Electric Vehicle and impact of electrical vehicle in power system. Charging and discharging effect of electrical vehicle. What are impact occurred when electric vehicle connected in power system. Impact of Electric Vehicles Discharging on Grid Economy investigated the harmonics, distortion in voltage and power ratings linked with the diverse chargers of EV. In this discussed many key issues like forecasting, power quality, effect of charging and discharging of EVs on the grid, and alluded vacillating matters to present the guidelines to many research areas.

Tarek Hassan *et al* 2018[11], has studied about V2G system under the topic “Terminal Voltage and Power Regulation Using Vehicle-to-Grid (V2G) Schemes Connected to a Two-Area Power System” This paper presents two area power smart grid connected V2G system. In this study are consider 5 type of condition of vehicle connected to grid and determine fault condition. In this study case control the frequency regulation. In this research paper, integrating the proposed V2G into power system has proven to improve the total grid performance, in terms of its terminal voltages, power, and frequency.[7,8,10]

Wooyoung Choi *et al* 2017[2], has studied about V2G system under the topic “Reviews

on Grid-Connected Inverter, Utility-Scaled Battery Energy Storage System, and Vehicle-to-Grid Application –

Challenges and Opportunities “The purpose of this paper is to review three technologies for grid-connected distributed energy resources in the power system: grid-connected inverters (GCIs), utility-scaled battery energy storage systems (BESSs), and vehicle-to-grid (V2G) application. The overview of GCIs focuses on topologies and functions. Different functions of utility-scaled BESS are introduced and a comprehensive review is provided for currently operating BESSs that are interconnected at the distribution level. Possible grid support functionality of utility scaled BESS are presented.

Farhad Khosrojerdi *et al* 2016[3], Electrification of a transportation system is one of the most promising alternatives to mitigate the dependency of urban life to fossil fuels. However, by introducing a large number of grid connected vehicles reveals technical problems which affects the entire power system, especially the low voltage section. In this study this paper presents a review of technical challenges associated with the integration of Vehicle-to-Grids (V2Gs). This study the existing technical challenges, when V2Gs are widespread in a smart grid, as well as the Yimin opportunities for the smart power distribution implementation.

Yimin Zhou *et al* 2015[1], In this paper describe about V2G system. According to this paper in this paper describe these points

- V2G’s intelligent dispatch from the power grid perspective
- V2G based intelligent charging and discharging from electric vehicle(EV) users’ perspective
- The effects of V2G on the battery
- V2G bidirectional charging system

Koduri *et al* 2014[6], The increasing oil demands and the economic concerns have

inspired the government, car manufactures and the environmentalist to promote the manufacturing of Electrical Vehicles (EVs). With developments in the power grid and advancements in the vehicle technology the EVs can contribute to the grid by selling or buying power from the grid. For the effective and efficient use of the V2G system there is a large scope to develop the V2G integrators like OnBoard and Off-Board. In this research paper the On-Board V2G integrator is proposed and is modeled using MATLAB/SIMULINK. The conversion efficiency obtained is 90% and the benefits of V2G system are listed. This paper focus on following points-

- Simulation of smart grid connected V2G system.
- Simulation of smart grid connected V2G system connected to utility grid.
- Comparison between smart grid connected V2G system and smart grid connected V2G to utility grid system.
- Reducing transient from V2G system

PROPOSED WORK

In this study there are two cases consider. .
 • Smart Grid connected V2G system.
 • Smart Grid connected V2G system connected with Utility Grid.

In these study are obtain comparison of smart grid connected V2G system and smart grid connected V2G system connected with Utility Grid. In this study proposed simulation of MATHWORK/MATLAB based model of V2G system and Utility Grid connected V2G system. Reducing the transient effect and control stability V2G system and grid by using Utility Grid connected V2G system.

VEHICLE-TO-GRID (V2G)

V2G is a full form of Vehicle-To-Grid. The V2G mean is vehicle connected to grid. There are three type of V2G framework

- Vehicle-To-Home (V2H)
- Vehicle-To-Vehicle (V2V)

- Vehicle-To-Grid (V2G)

If the supply from sources gets interrupted we can steel charge the cars or can supply the residential load with the help of utility grid. Whenever extra power is generated to not to stop the generating plant (source unit)-Diesel Generator, Wind Farm, and PV Farm etc., this power is delivered to V2G system and utility grid. Whenever the extra power demand are required and the Smart Grid does not fulfill power demand than these demands are fulfilled by V2G system and Utility Grid system. Proposed work implemented on MATLAB/SIMULINK software and shows comparison between V2G System

CONCLUSION

This study compare between smart grid the utility grid when V2G system without utility grid system decreases the transient of V2G system improves the stability of the V2G system. V2G system connected with Smart Grid and V2G system connected with Smart Grid with Utility Grid. Thus obtain a result whenever Utility Grid is connected to V2G system so decrease the transient of V2G system. When transient are decreases so improve the stability of V2G system.

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