COMPARISON BETWEEN UTILITY GRID CONNECTED V2G SYSTEM AND WITHOUT UTILITY GRID CONNECTED V2G SYSTEM

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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 paper 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.

IndexTerms – Smart grid, Vehicle-to-Grid (V2G), Electric Vehicles, Power, AC.

I. INTRODUCTION

Vehicle-to-Grid (V2G) networks are important components of smart grid (SG), which provide charging service for large-scale plugin electric vehicles (PEVs) and make vehicles as mobile and distributed storage unit accessing to smart grid. 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 sensitive information, such as PEV's location, trip data, payment information, battery state, and user preference, etc., the 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.

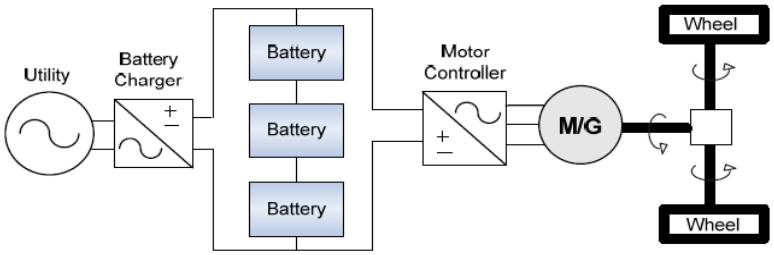

Figure 1: EV Configuration

A typical electric vehicle (EV) has a battery pack connected to an electric motor and provides traction power through the use of a transmission. The batteries are charged primarily by a battery charger that receives its power from an external source vehicles. Such as the electrical utility. Also during regenerative braking, the motor acts as a generator which provides power back to the batteries and 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 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 battery charging method.

II. LITERATURE SURVEY

Uwakwe Chukwu et. al 2018, Proposed models of V2G as a PQ unit. The power flow study is developed from Newton Raphson's 3-Phase Current Injection formulation. The mathematical basis for voltage studies is presented. Also various impacts on the voltage profile for V2G operations in different modes of operation are investigated. Results indicate that the extent of voltage impact depends on the V2G mode of operation, size of the network and whether the V2G integration is 1-phase or three-phase. This study would be useful in the design, management, and operations of the electric network with significant V2Gs.

Wooyoung choi et. al 2017, 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 emerging technologies for grid-connected distributed energy resource 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 functions of utility scaled BESS are presented.

Farhad Khosrojerdi et. al 2016, has studied about V2G system under the topic "Integration of Electric Vehicles into a Smart Power Grid: A Technical Review" Electrification of transportation system is one of the most promising alternatives to mitigate the dependency of urban life to fossil fuels. However, introducing a large number of grid connected vehicles reveals technical problems affecting the entire power system, especially the low voltage section. In this context, this paper presents a review of technical challenges associated with the integration of Vehicle-to-Grids (V2Gs). These challenges are studied in several subsections of a power system such as the operation of power electronics equipment, supply-demand imbalance, and impacts on voltage and frequency.

Chen Jie, et. al 2015, In this work, propose a secure and efficient authentication scheme with privacy-preserving for V2G networks. The scheme makes the charging/discharging station authenticate PEVs anonymously and manage them dynamically. Moreover, the monitoring data collected by the charging/discharging station could be sent to a local aggregator (LAG) in batch mode. In particular, time overheads during verification stage are independent with the number of involved PEVs, and there is no need to update the membership certificate and key pair before PEV logs out.

Salman Habib et. al 2014, has studied about V2G system under the topic "A Novel Vehicle-to-Grid Technology with Constraint Analysis-A Review" This paper presents a detailed review of a vehicleto- grid (V2G) technology, and analyzes its impacts on power distribution networks. It is shown in this study that a vehicle, equipped with the ability of a V2G application, offers various features such as regulation of active power, support for reactive power, load balancing, current harmonics filtering etc. These features can enable ancillary services including, spinning reserve and control of voltage and frequency. However, the technology of V2G also creates challenging issues, for instance, degradation of batteries, communication overhead between an EV and a grid, changes in whole infrastructure of a distribution network (DN).

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.

III. PROPOSED WORK

A. GRID

Electric grid is a network of synchronized power providers and consumers that are connected by transmission and distribution lines and operated by one or more control centers. The digital technology that allow for two way communication between the utility and its customers, and the sensing along the transmission line is what make the smart grid. Utility Gird is a simple conventional grid. In the utility grid mainly nonrenewal energy sources are considered. In the Utility Grid mainly diesel generator and coal based generator system are included. In this type of grid are not two way communication and two way information system present here.

B. VEHICLE TO GRID (V2G)

The growing environmental concerns and strive for increased efficiency in private mobility has drawn the attention of car companies and associated entities to manufacture Plug-in electrical vehicle (PHEV) or pure electrical vehicle (PEV) or Electrical Vehicles (EV). The electrification of vehicle feet will reduce oil demands and lessens the carbon emission. The EVs can be integrated to the grid to sell or buy the power from the grid and the concept is called Vehicle-to-Grid (V2G). The V2G plays a prominent role in fulfilling the grid requirements and meet the load demands. V2G can be used for peak shaving or valley filling. The single EV can consume but cannot deliver power to the grid. The group of EVs makes a sizeable difference and delivers power to the grid. The EVs also support the ancillary services like load leveling, voltage regulation, frequency regulation and balancing. The EVs need bidirectional charger to sell or buy power from the grid. Further the bidirectional charger has the direct current (dc) link capacitor which is inherently able to provide the reactive power support to the power grid.

C. SMART GRID CONNECTED V2G SYSTEM

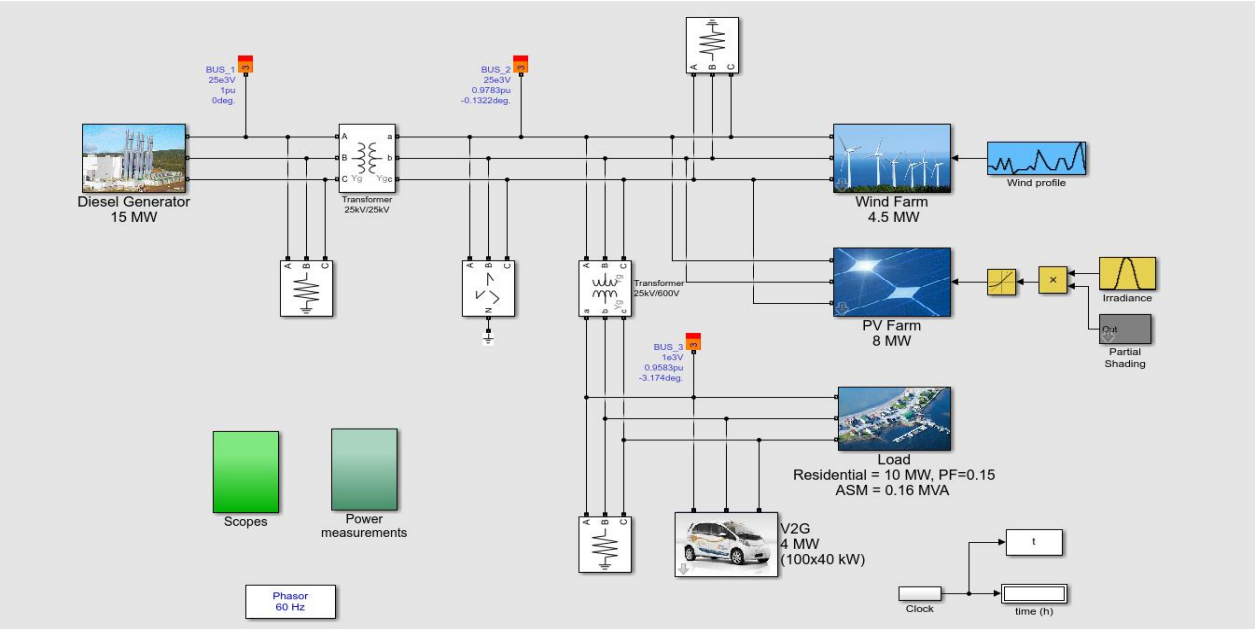

Figure 2: Smart Grid connected V2G system

The above diagram is represent a Smart Grid connected V2G system. This system is representing 24 hour representation.

- This simulation model have 3 source
  1. Diesel generator -15 MW
  2. Wind farm -4.5 MW
  3. PV Farm- 8 MW
- Load
  1. Residential load – 10 MW,PF0=.15,ASM=0.16 MVA
  2. 3 ,3 phase RLC load
- V2G
  1. 100 vehicles.
- Transformer
  1. 3 Phase Transformer – 25KV/25KV
  2. 3 Phase transformer 25KV/600V
  3. Grounding transformer

D. UTILITY GRID CONNECTED WITH SMART GRID V2G SYSTEM.

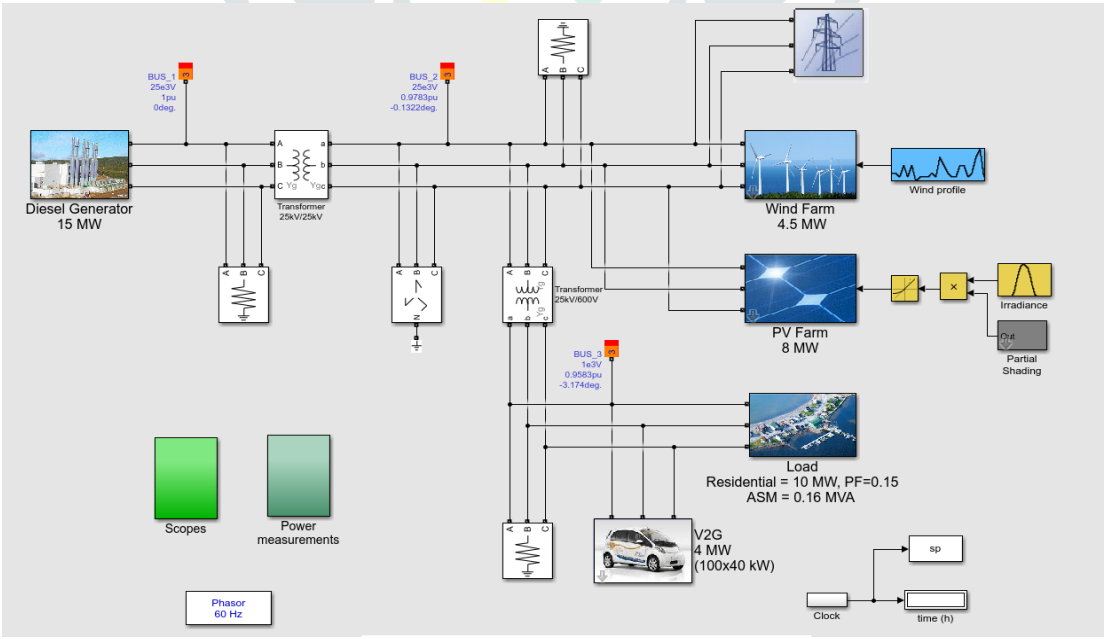

Figure 3: Smart Grid connected V2G system

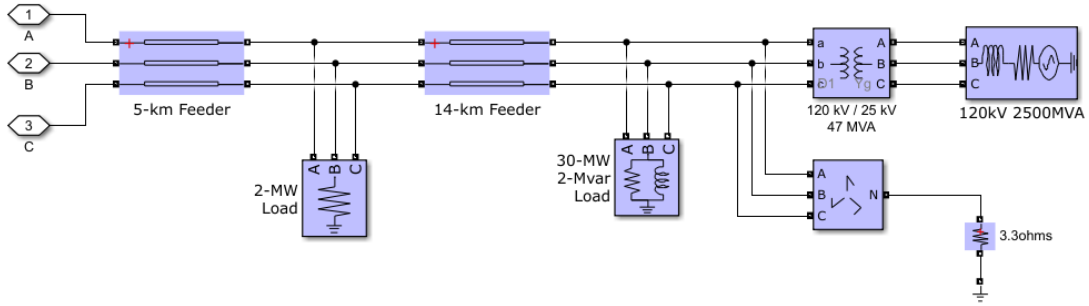

Figure 4: Utility Grid

The above diagram is represent a Smart Grid connected V2G system with Utility Grid. This system is representing 24 hour representation. In proposed model, apply 600v utility grid apart of previous source details.

IV. SIMULATION RESULT

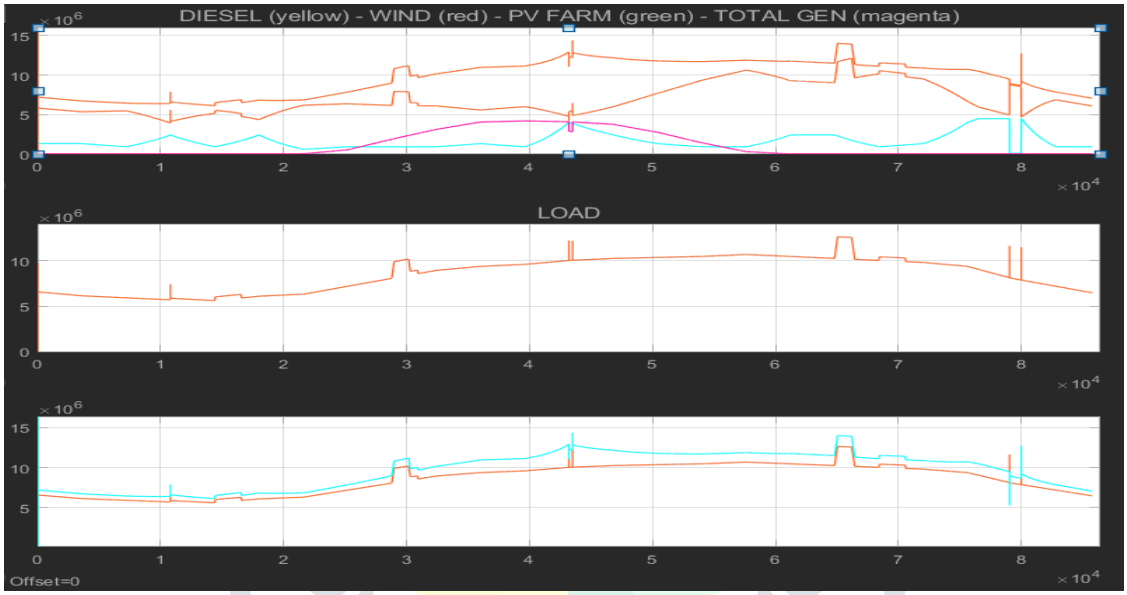

Figure 5: Total Power of V2G without Utility Grid

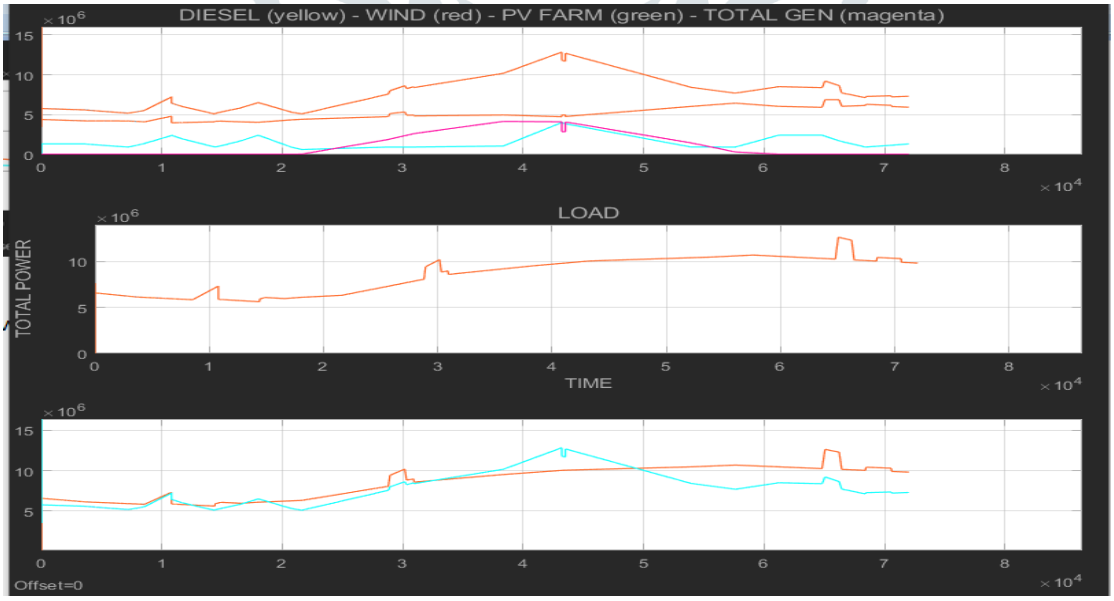

Figure 6: Total Power of V2G with Utility Grid

There are decreased amount of transients present in the output waveforms of total power of V2G system when Utility Grid is connected.

Table 1 Diesel Generators

Source	Parameter	Without utility Grid Approximate Transient	With utility Grid Approximate Transient
Diesel Generator	Voltage	$0.1*10^5$	$0.1*10^5$
	Current	400	200
	Total power	$1*10^7$	$0.8*10^7$
	Active power	$1*10^7$	$0.3*10^7$
	Reactive power	$0.5*10^7$	$0.4*10^7$

Table 2: Load

Source	Parameter	Without utility grid approximate transient	With utility grid approximate transient
Load	Voltage	20	20
	Current	15000	14999
	Total power	$10*10^6$	$10*10^6$
	Active power	$-6*10^6$	$-6*10^6$
	Reactive power	$-2.4*10^6$	$-2*10^6$

Table 3: Rotor Speed of Diesel Generator

Diesel Generator Rotor Speed	Parameter	Without Utility Grid Transient
Rotor Speed	Diesel Generator Without Utility Grid	1.005
	Diesel Generator With Utility Grid	1

V. CONCLUSION

This paper compare between smart grid connected V2G system without utility grid and smart grid connected V2G system with utility grid, and the result shows that the utility grid when connected to the V2G system decreases the transient and improves the stability of the V2G system. If the supply from sources gets interrupted we can steel charge the cars or can supply the residential load with the utility grid. Whenever extra power are generated so not the stop 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 not fulfill power demand so these demand fulfill by V2G system and Utility Grid system. Proposed work implemented on MATLAB/SIMULINK software and shows comparison between 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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