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BATTERY AND DIESEL POWERED ELECTRIC VEHICLE CHARGING STATION OPERATED BY SOLAR PV

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Abstract: Our plan is to use solar panels, batteries, and a diesel generator to construct a charging station for electric vehicles. In this investigation, isolated, grid-connected, and DG-connect modes are employed to continuously load a PV (photovoltaic), power storage unit, DG generator, and grid-based EV charging station (CS). Energy and the storage of electrical energy are important to this endeavor. The EVs' batteries are charged using power from the solar PV&BES array at the charging station. When the station's batteries are depleted or the sun isn't shining, it will switch to using grid energy (a Diesel Generator). However, the power from the DG collection is generally pulled in such a manner that it operates with a charge of only 80% to 80%, in order to maximum fuel efficiency. The charger, in combination with the storage battery, regulates the generator's output and frequency, eliminating the need for a mechanical speed control. The Common Coupling Point (PCC) voltage must be equal to the grid voltage and the generator voltage in order to keep the load constant. The charging station guides the vehicle to maximize the utilization of grid active/reactive transmission, residential electricity, and vehicle power transfer. The effectiveness of the charging station is evaluated using Mat lab/Simulink.

Keywords: Electric Vehicles (EVs) Point of Common linkage (PCC), Solar Photovoltaics, Batteries

I. INTRODUCTION

Electric vehicles (EVs) are becoming more popular because of their low energy consumption and absence of exhaust pollutants. It is estimated that there are now roughly 3 million cars on the road, and it is expected that this number will expand to 100 million by 2030, making EVs a huge benefit for auto fleets. Despite the need of putting in place the necessary charging infrastructure and a massive quantity of electrical energy, this alone will not

enough. Renewable and sustainable electrical energy is required to charge EVs, which is a key component of their overall sustainability. As long as fossil fuels are still being used to provide electricity, emissions are only being transferred to other areas. The only feasible source of power production is renewable energy, hence switching to this method has dual environmental benefits. Given the widespread deployment of renewable energy sources like photovoltaic (PV) arrays, wind turbines, hydroelectric dams, and fuel cell-based generators, it is likely that PV-based energy generation will be the most accessible and cost-effective choice for EV

charging in both suburban and urban areas. Availability throughout the Indian subcontinent is almost constant throughout the year. Whereas solar

photovoltaic (PV) arrays are often erected in regions with abundant sunshine, wind and hydro power are more location specific. Wind energy is mostly used at the shore, whereas hydro energy is helpful inland.

A renewable-energy charging facility is the worst possible choice since it requires yet another level of energy conversion, making the charge system more complicated and weaker. Each phase of the transformation has its own control unit, which must be integrated into the overall control architecture. In order to coordinate and govern several independent sources, it is crucial to create a system that can function in more than one manner. There have been several efforts to create charging stations that run on renewable energy. Ugirumurera et al. [3] point out the need of renewable energy for the long-term viability of the EV charging station. Solar energy has been utilized to charge EVs using a high power bidirectional EV charger, as reported by Mouli et al.

[4]. However, it is not compatible with the AC charger that is currently available. Three-port converters were designed by Monterio et al. [5] to combine solar energy with electric vehicle charging infrastructure. Although the charger was constructed to handle such distortions, the design makes no allowances for the current grid distortions that are a result of the charger's operation. Singh et al. [6] presented an enhanced converter for a PV array/grid-connected electric vehicle loader. The charger is not optimized for this mode of operation, but it does function well inside it. As a result, EV charging cannot proceed until the infrastructure supporting it is complete. The optimization model for battery storage management has been developed by Chaudhari et al. [7], who aim to lessen the financial burden of charging stations while making the most of the energy produced by solar PV systems. In April, Kineavy et al. [7] suggested coordinating off-site EV loading (under unpredictable circumstances) with on-site PV production (usable in commercial buildings) to get the most out of the solar photovoltaic array. Study group Zhang et al. [9] looked studied how a dual-mode charging station for electric vehicles was set up at the workplace. Because of this, it may be used both in the cloud and on-premises to provide high quality service at a low total cost of ownership. Charging has less of an effect on the power grid as a result. A commercial solar PV system with on-site batteries for energy storage has been shown to reduce costs by a significant amount (Kandasamy et al., 11). Due to its day-and-night availability and plenty of supporting research [12], [13], the CS wind energy station is a great choice for EVs.

Research into renewable energy-based charging stations has focused on optimizing a wide range of charging factors. To yet, however, only a small percentage of publishing houses have installed charging stations powered by renewable energy. In addition, the functionality of charging stations in the real world is seldom acknowledged.

Furthermore, the bulk of literature only describes grid-connected or islanded functioning of CS. The panel is useless if the grid is down, even though it can only be used in grid-connected mode. When in islanded mode, PV power is interrupted periodically. In light of this, a storage battery is necessary for dealing with the impacts of variable solar irradiation [14].

Here are a few of the most notable things that were added to this publication.

1) Detailed smart grid integration, comprising a design and experimental validation of PV array, energy storage, and a distributed generating set, will enable both direct current (DC) and alternating current (AC) charging of electric vehicles (e.g., power stations, solar farms, etc).

2) The loading station's design incorporates two crucial aspects: the ability to function in many operating modes (insulated, grid-connected, and DG-set linked) while only requiring a single VSC.

3)The charging station's mode-switching circuitry enables it to seamlessly convert between modes, ensuring a constant supply of power.

4)An effective control method is required for V2V charging to be implemented. However, power transmission from vehicles to the grid is essential for vehicle-to-grid (V2G) assistance.

5)Power is transferred at a power factor of 1 when the charging station's active power filter is activated. This is required to adhere to IEEE-519 guidelines.

6)Instead of using a mechanical voltage regulator, some users utilize an automated voltage regulator (AVR) to fine-tune the frequency and voltage of their DG sets.

7) The different plan to keep the additional solar power produced and sent into the grid so as not to overcharge the battery storage.

II. EXISITNG SYSTEM

The performance of CS in its current form is only ever considered in one of two situations in present methods: either in grid-connected mode or in islanded mode. The panel is useless if the grid is down, even though it can only be used in grid-connected mode. When in islanded mode, PV power is interrupted periodically. As a result, a storage battery is essential for mitigating the impacts of variable solar irradiation. When charging the storage battery, the Maximum Power Point Tracking (MPPT) feature must be disabled to prevent the battery from being overcharged. The accompanying diagram depicts the combined control of voltage source converter for freestanding grid |& DG set connected mode with existing PI controller.

III. PROPOSED SYSTEM

The EV may be supplied with electricity from the grid, a solar photovoltaic (PV) array, a battery storage system, or a demand response generator. To get from the solar photovoltaic array to the storage battery, a voltage converter (VSC) must be connected to the DC connection. On the AC side of the VSC there is a single SEIG, an EV, and a non-linear load. At Panhandle Collegiate University, a ripple filter is used to attenuate grid and generator current harmonics (PCC). An auxiliary winding is connected to a condenser and then positioned at a certain location. The SEIG has a condenser built in to provide a temporary reservoir. A synchronization switch regulates the connection and disconnection of a charging station from the power grid.

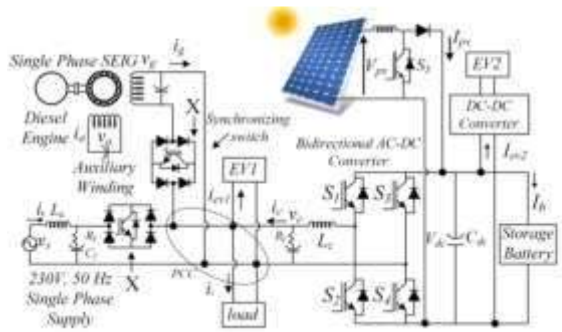


Fig. 1 Proposed system configuration

IV. PROPOSED CONTROL SYSTEM

Both the direct current charge and the solar PV generating may be handled by the storage battery without requiring major adjustments to the system's management. But because the VSC system does not have a grid voltage, a dedicated VSC controller is often required to achieve the local voltage standard in reality. To create the internal voltage reference of 230V&50 Hz, we follow the reasoning shown in figure.2. The reference converter current is determined by comparing the produced reference with the converter terminal voltage. The PI controller uses the determined reference current to determine the reference converter current.

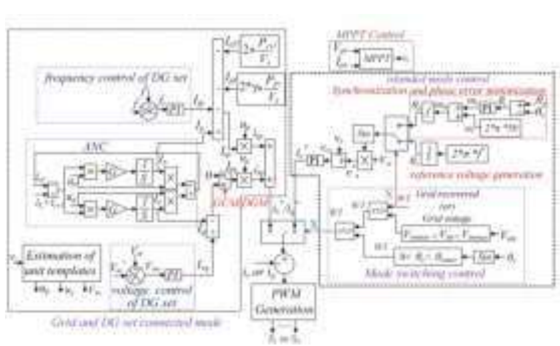


Fig. 2Control system

DG Set Control for Voltage&Frequency

Because of the VSC decoupling control, the DG set may be operated from a single location. It may be adjusted to modify the DG set's resonance and tension. Voltage and frequency may be regulated by adjusting the active and reactive powers, respectively. Two PI controllers are required for voltage and frequency control. Consequently, a few of switches will be required. What follows are the outcomes predicted by the PI voltage controller.

$$I_{vq}(s)=I_{vq}(s-1)+z_{vp}\{V_{me}(s)-V_{me}(s-1)\}+z_{vi}V_{me}(s) \quad (1)$$

Zvi&zvp are the controller gains for a PI controller. A simplified form of the PI equation for the controller's frequency is

$$I_{fp}(s)=I_{fp}(s-1)+z_{fp}\{f_e(s)-f_e(s-1)\}+z_{fi}f_e(s) \quad (2)$$

The PI gain values (ZKFP, ZFI) are based on the FE, which is supplied by the PI error estimate.
The combined outputs of the frequency and voltage controllers are shown in Figure 2 for grid-connected control. However, when these controllers are wired into the grid, their outputs are completely muted.

VI.SIMULATION RESULTS

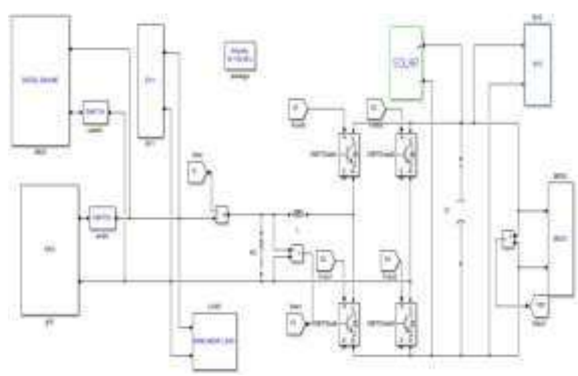


Fig.4MATLAB/SIMULINK circuit diagram of the proposed system

RESULTS

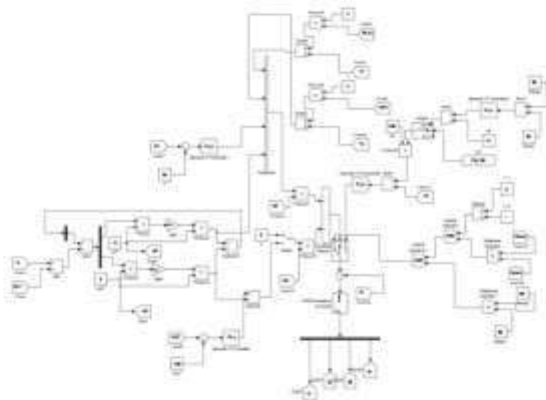


Fig.5 Controller subsystem with PI controller

The many modes of operation are shown in figures 6 through 14. The THDs of the grid voltage, current, load current, and generator current are shown in additional figures 11, 12, 7(a), and 14(a).

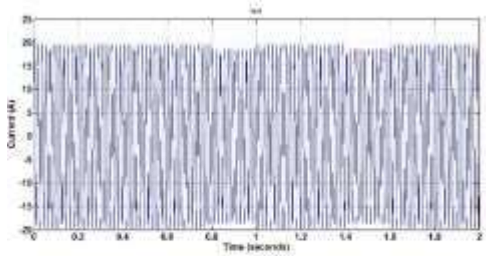
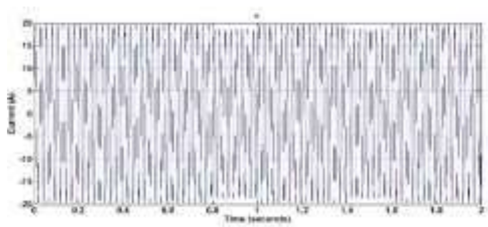
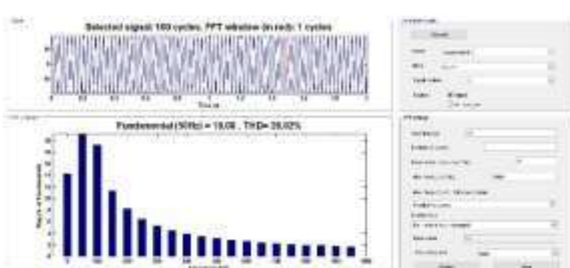


Fig.6Current of EV1



(a)



(b)

Fig.7(a) Current at Load&(b) Load currentTHD is 28.02%

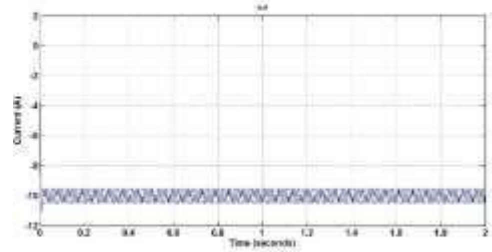


Fig.8Current of EV2

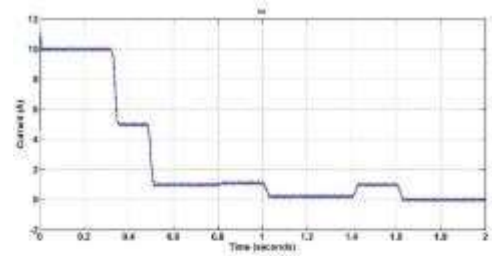


Fig.9Current (photovoltaic)

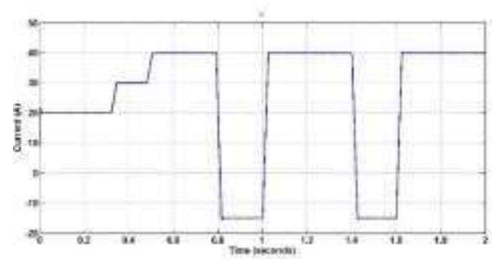
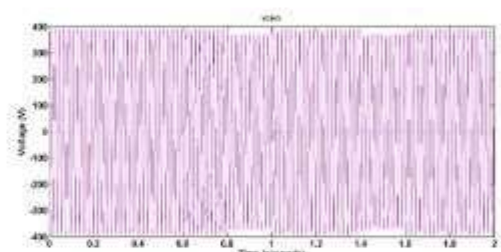
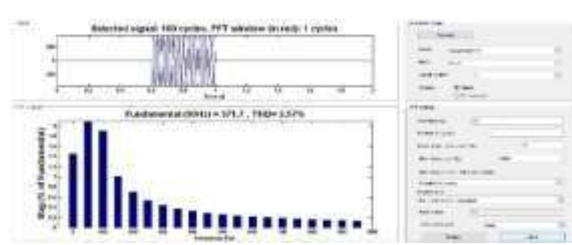


Fig.10Current (Battery)

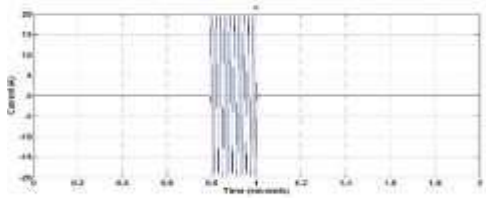


(a)

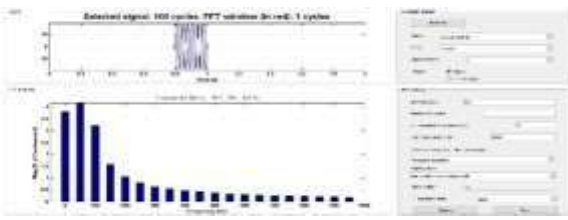


(b)

Fig.11 (a) Voltage atPCC&Voltage at theGrid (b) Grid voltageTHD is 2.57%



(a)



(b)

Fig.12(a) Current of the Grid(b) Grid current THD is 4.11%

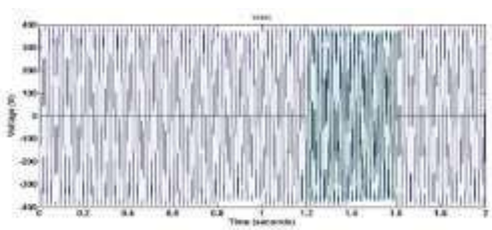
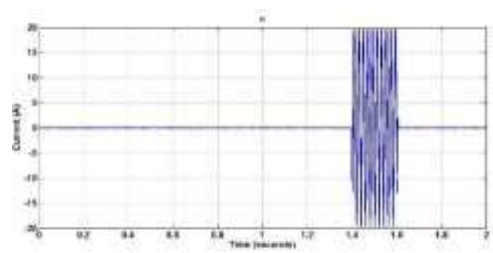
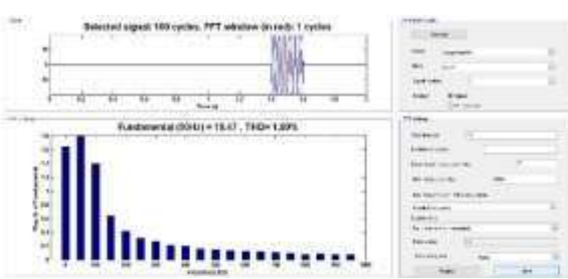


Fig.13Voltage of generator&voltage at the PCC



(a)



(b)

Fig.14 (a)Current at theGenerator&(b) Generator current THDis 1.80%

CONCLUSION

Photovoltaic (PV) panels, storage batteries, the electric grid, and a distributed charging station are all part of this project's plan to keep electric vehicles (EVs) juiced. Possible findings have shown that a single VSC may power the CS in three different configurations (island operation, grid connection, and DG set connection). The results of the tests confirm that the charging station functions as a reliable, self-contained generator. With the new, more efficient PV array technique and the optimized DG set charging, the odds of getting MPP performance from the PV array are increased, and consistent charge is provided. In order to maintain IEEE approval, the charging station must demonstrate proper operation with each voltage&current THD test.

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