Journal of Contemporary Issues in Business and Government Vol. 23, No. 01, 2017
https://cibgp.com/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

A NEW CONTROL STRATAGY FOR SOLAR PVT- BATTERY AND DIESEL GENERATOR BASED EV CHARGING STATION

[1]***MR. B.RAJU ASSISTANT PROFESSOR BANOTHU.RAJU12@GMAIL.COM***
[2]***MR. V.SAIDULU ASSISTANT PROFESSOR PECSAIDULU.EEE@GMAIL.COM***
[3]***MR. VENKATESWAR RAO ASSISTANT PROFESSOR VENKATSNMPKMM@GMAIL.COM***
DEPRTMENT-EEE
NAGOLE UNIVERISITY ENGINEERING AND TECHNOLOGY HYDERABAD

Abstract: The main aim of this project tis solar pv-battery & diesel generator-based EV charging station. This paper employs a PV (photovoltaic), a power storage unit, a DG generator, & a grid-based EV charge station (CS) to continuously load isolated, grid-connected & DG-connect modes. This project involves an energy & electronic energy storage plant. In this project, the PI controller is changed to a Fractional Order PID (FOPID) controller in the DG set, which can regulate the tension & frequency. The charging station is primarily intended to recharge the electric car battery (EV) with a solar PV & BES range. However, the charging station is intellectually electricity coming from the grid or DG in case of an empty storage battery & of the unavailable production of Solar PV array (Diesel Generator). The electricity in the DG collection is however drawn in such a way that it frequently works with an 80 to 80 percent charge in all charging situations to achieve optimal fuel efficiency. In conjunction with the storage battery, the charger also handles the power & frequency of the generator without the mechanical speed control. In addition, the PCC (Common Coupling Point) tension synchronizes for continuous loading with grid/generator voltage. The charging station leads the automobile to the active/reactive transmission of the grid, the vehicle to its domestic & the vehicle to the transference of vehicle power in order to optimize its operating efficiency. With Mat lab/Simulink software the operation of the charging station is validated.

Keywords: PV, Battery, Electric vehicle (EV), Point of common coupling (PCC), FOPID controller

I. INTRODUCTION

One of the most efficient ways of transportation is electric vehicles (EVs), which produce zero exhaust emissions. EVs give car fleets an enormous advantage, as it is estimated that about 3 million vehicles are already on the road, & it is predicted that this number would increase to 100 million by 2030. Although the construction of the required charging infrastructure & a vast amount of electrical energy are essential, that is not enough. To be sustainable, EVs require renewable & sustainable electrical energy to charge. While fossil fuels are still being used for energy generation, their emission is only displaced, not reduced. Because renewable energy is the only option for electricity generation, renewable energy usage eliminates emissions while providing a benefit to the environment. The availability of renewable energy sources, such as solar PV arrays, wind turbines, hydroelectric dams, & fuel cell-based generators, ensures that a solar PV-based energy generation method will be the most practical option for EV charging in both rural & urban areas. With regard to the Indian subcontinent, availability is nearly year-round. Conversely, while solar PV arrays are commonly installed in areas with strong sunlight, wind & hydro energy are region dependent. In the coastal region, wind energy is mainly used, but in the higher regions, hydro energy is useful.

The least favorable alternative is a renewable-energy charging plant, where a further energy conversion stage is introduced & the charge system becomes more complex & less powerful. In addition, a dedicated control unit needs to be integrated with the existing control for each conversion stage. Basically, it is important to construct an integrated system with multifunctional & multimode operating capability to have a unified control & coordination amongst all different sources. Renewable energy based charging stations have received many attempts to be developed. Renewable energy plays a key role in the sustainability of the EV charging station, as highlighted by Ugirumurera et al. [3]. According to Mouli et al. [4], a high power bidirectional EV charger has been used to charge EVs using solar electricity. However, the AC charger has not been specifically built for it. In a study by Monterio et al. [5], three-port converters were developed to integrate PV power with EV chargers. Even though the charger was built to deal with these distortions, No factors are considered in the design for the current grid distortions induced by the charger. An improved converter for a PV array/grid-connected EV loader was proposed by Singh et al. [6]. While the charger has not been created expressly for this particular operating mode, it works in that environment. Therefore, unless the grid is ready, it can not allow

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

EV charging. Chaudhari et al. [7] have described the optimization model for battery storage management, which seek to reduce charging stations' cost & to maximize the power generated by solar photovoltaic arrays. Kineavy et al. [7] proposed in April that the on-site PV generation (usable in commercial buildings) with off-site EV loading (under uncertain conditions) be coordinated to maximize the use of the solar photovoltaic array & minimize its influence on the grid. The Zhang et al. study group [9] examined how the EV charging station was optimized for a workplace with two charging modes. It is also suitable for deployment on site to provide the best service with a smaller overall ownership cost. The grid impact of charging is also reduced. In a study by Kandasamy et al. [11], an amount of money can be saved using a commercial solar PV system based on buildings for battery loss storage. The CS wind energy facility is especially excellent for EV, as it has both day & night time availability, & there are plenty of studies to assist [12] [13] in this field.

Various charging considerations, including renewable energy resources, storage unit size, travel patterns for vehicles, loading times & cost, have been optimized in studies of renewable energy-based charging stations. However, today few publishers have incorporated renewable energy sources in their charging stations. In addition, charging station's performance in the actual world is rarely discussed.

Additionally, in the majority of the literature, only the grid-connected or islanded operation of CS is described. Although the panel can only be used in grid-connected mode, it is still ineffective if the grid is unavailable. The PV power is intermittently interrupted when operating in islanded mode. Thus, to manage the effects of fluctuating solar irradiation, a storage battery is required [14]. In order to minimize overloading of the storage battery, however, maximum power point tracking (MPP) must be disabled.

In this paper the following contributions were particularly remarkable.

1) Detailed smart grid integrating will allow both DC & AC charging of EVs, including a design & experimental validation of PV array, energy storage & a distributes generation set (e.g., power stations, solar farms, etc).

2) Two essential features in the design of the loading station are that it may be used without hardware changes by many working modes (insulated, grid-connected & DG-set connected), with a single VSC for usage in all these modes.

3) The charging station's mode-switching circuitry allows it to smoothly switch modes so it can deliver continuous charge.

4) For vehicle-to-vehicle (V2V) charging, a control strategy that is effective is required. For vehicle-to-grid (V2G) support, however, V2G power transfer is required.

5) When the active power filter function of the charging station is in force, the power exchange happens at unity power factor. This is required in order to comply with the IEEE-519 standard.

6) Some people use an automatic voltage regulator (AVR) to adjust the frequency & voltage of DG sets without needing a mechanical voltage regulator.

7) An alternative strategy to save the extra solar power generated & fed into the grid to avoid overcharging the battery storage.

II. EXISITNG SYSTEM

In existing method the he performance of CS, as it is practiced now, is only discussed in one of two scenarios: in grid-connected mode or islanded mode. Although the panel can only be used in grid-connected mode, it is still ineffective if the grid is unavailable. The PV power is intermittently interrupted when operating in islanded mode. Thus, to manage the effects of fluctuating solar irradiation, a storage battery is required. To avoid overcharging the store battery, you must deactivate the Maximum Power Point Tracking (MPPT) when charging the storage battery. The below figure indicates the Combined control of voltage source converter for standalone grid |& DG set connected mode with existing PI controller

III. PROPOSED SYSTEM

For powering & charging, the EV can be powered & filled by a photovoltaic (PV) array, a storage battery, a demand-side management unit (DG) & grid energy.

The DC connection voltage converter (VSC) connects to the solar PV array that, in turn, links the boost to a storage battery. There is single SEIG, an EV, & a non-linear load linked on the AC side of VSC. Harmonics are reduced on the grid & the generator current using a ripple filter on the campus of Panhandle Collegiate College (PCC). A condenser is placed with an auxiliary winding attached to it. The SEIG is equipped with a condenser to make a small reservoir for the time span. A synchronization switch is used to manage the connection & disconnection of a charging station to the grid.

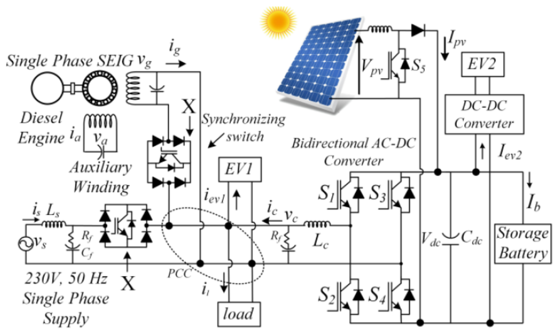


Fig. 1 Proposed system configuration

IV. PROPOSED CONTROL SYSTEM

The DC charge & the solar photovoltaic generation can be handled with the storage battery without much management adjustment. In practice, however, a separate VSC controller is necessary to achieve the local voltage benchmark, since the VSC system does not have a grid voltage. Based on the logic stated in the figure, the internal voltage reference of 230V & 50 Hz is formed in figure.2, as detailed. A comparison of the generated reference with that of the converter terminal voltage is used for calculating the reference converter current. The calculated reference current is then used on the FLC controller to calculate the reference converter current.

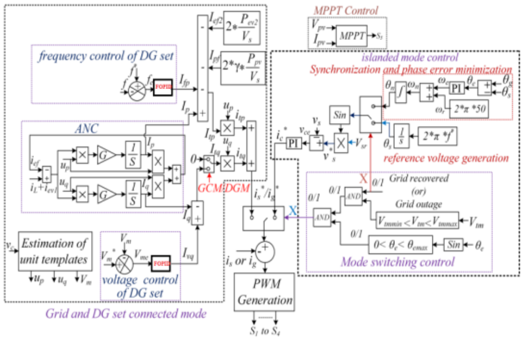


Fig. 2 Control system

DG Set Control for Voltage and Frequency with FOPID

For working the DG set at single point, the rehash and voltage of DG set are coordinated utilizing decoupled control of VSC. In decoupled control, the rehash is overseen by the astonishing power and the voltage is made by responsive power. Suitably, two PI regulators are utilized for voltage and rehash rules. The PI control for voltage rule is given as,

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

Where Me=Vim*-Vim and the Ziv and zip are the FOPID controller gains. In this way, the desecrate enunciation of the repetitive FOPID controller is as,

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

Where fee is the screw up in rehash and skip, ziff is FOPID gains.

The eventual outcomes of the rehash and voltage regulators are consolidated organization related control as displayed in Fig. 5.3. In any case, the eventual outcomes of these regulators become zero in network related mode as the voltage and rehash of the cross segment stay controlled.

V. FOPID CONTROLLER

The fractional order PID controller which first time has been proposed by Podlubny in 1999 [22], is the expansion of the conventional PID controller based on fractional calculus. The general form of fractional order PID controller is $P\,I^{\alpha}D^{\beta}$ where and which are not necessarily integer, but any real number, and its general transfer function is given by (3):

$$G(s) = K_P + K_I S^{-\alpha} + K_D S^{\beta} \qquad (3)$$

The existence of five optimization parameters, K_P, K_I, K_D, α, β makes designing of a FOPID controller more challenging than for conventional PID controller. Several methods have been proposed for this design by using of optimization methods. In this work, this aspect is not tackled. The determination of the five parameters is achieved by successive iterations during the simulation study of the system.

VI.SIMULATION RESULTS

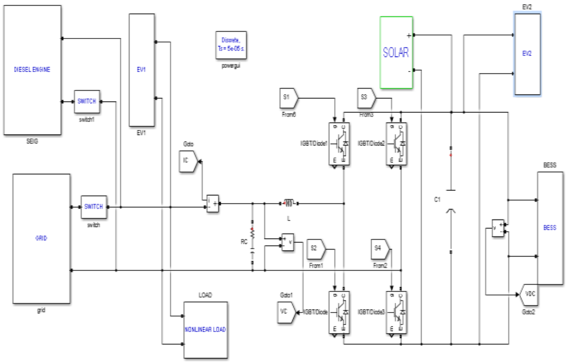


Fig.4 MATLAB/SIMULINK circuit diagram of the proposed system

A) EXISITNG RESULTS

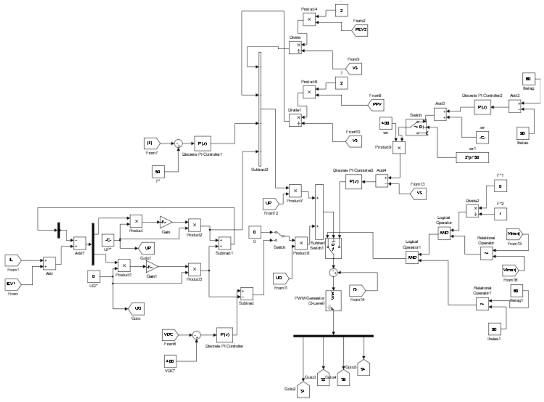


Fig.5 Controller subsystem with PI controller

The following figures 6 to 14, depict the various operating modes. Additional figures 11, 12, 7(a) & 14(a) display the THDs of grid voltage, current, load current, & generator current.

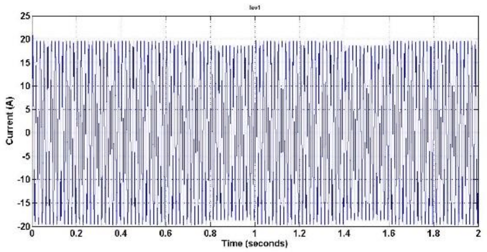
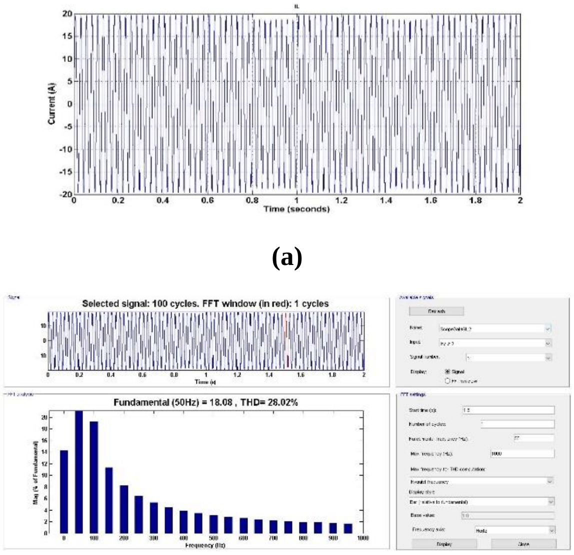


Fig.6 Current of EV1



(a)

(b)

Fig.7 (a) Current at Load & (b) Load current THD%

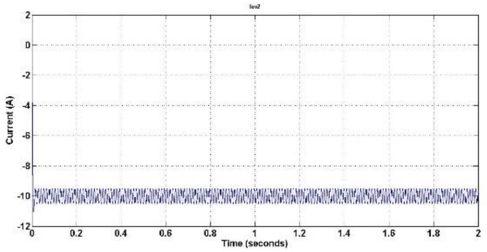


Fig.8 Current of EV2

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

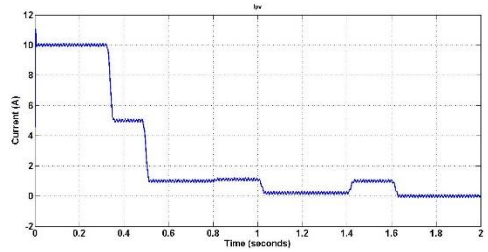


Fig.9 Current (photovoltaic)

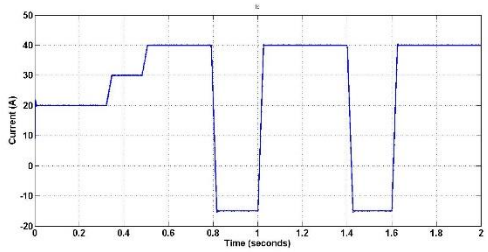
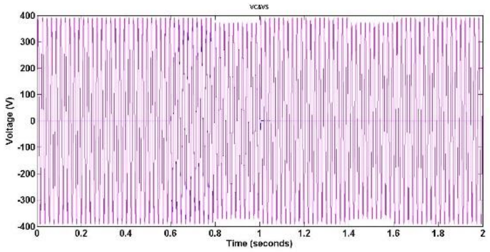
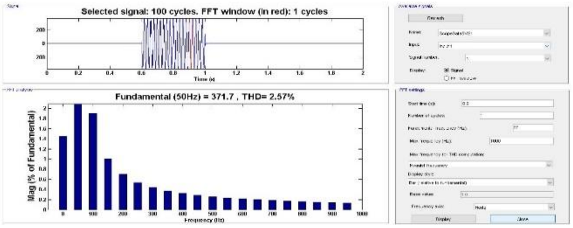


Fig.10 Current (Battery)



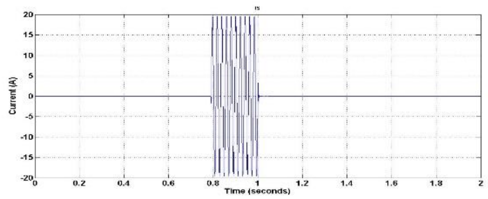
(a)


Selected signal: 100 cycles. FFT window (in red): 1 cycles

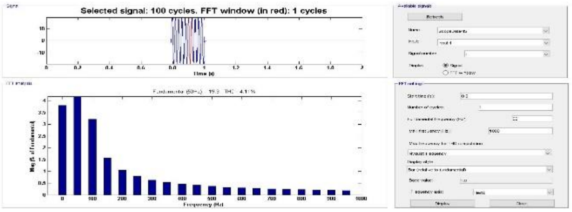
Fundamental (50Hz) = 371.7 , THD= 2.57%

(b)

Fig.11 (a) Voltage at PCC & Voltage at the Grid (b) Grid voltage THD%



(a)


Selected signal: 100 cycles. FFT window (in red): 1 cycles

Fundamental (50Hz) = 19.3 , THD= 4.11%

(b)

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

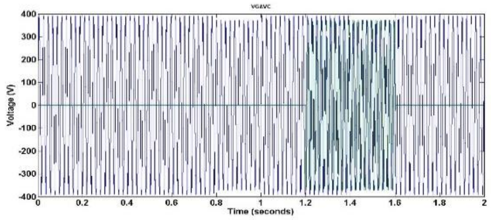
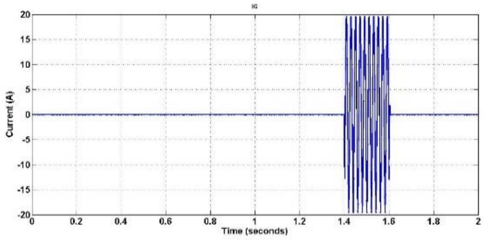
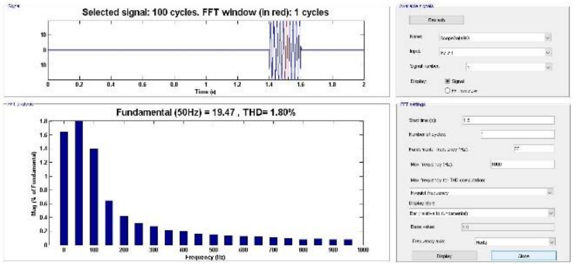


Fig.13 Voltage of generator & voltage at the PCC



(a)


Selected signal: 100 cycles. FFT window (in red): 1 cycles

Fundamental (50Hz) = 19.47 , THD= 1.80%

(b)

Fig.14 (a) Current at the Generator & (b) Generator current THD%

B) EXTENSION RESULTS

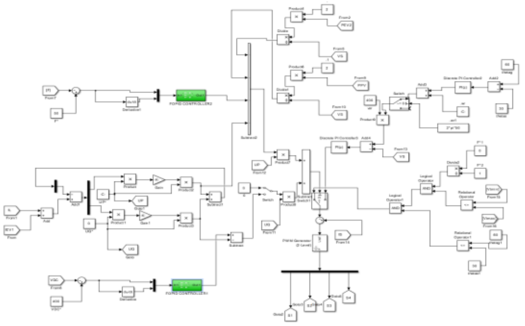


Fig. 15Controller subsystem with FOPID controller

Fig. 16 to 20 shows the uninterrupted operation of the CS simulated results. When the CS is first initialized, it's running in the islanded mode, & the PV array's electricity is being sent into the PCC's chargers to charge the EVs connected. The generation that exceeds the changing needs of the EVs is held in the energy storage until PV array generation decreases. As it gets to 0.32 seconds, the sun irradiation is reduced from 1000 watts per square meter to 300 watts per square meter. As a result, the PV array's power output is reduced, & the storage battery's charge begins to discharge to maintain the charging process uninterrupted. At the time of discharge, the storage battery is finished charging, as the PV array power has gone to zero. When the SOC is greater than Socking, the battery is fully charged. Once the battery has been completely discharged, the controller connects the CS to the grid. Then, at 0.79 seconds following synchronization, the CS begins to receive electricity from the grid. Figure 16 illustrates an auto-changing charging mode. It goes from Fig. 16 to Fig. 20, where the charging station automatically adjusts its modes based on generation & demand. By looking at the THD of a suggested system, we see that it is smaller than when we were measuring the THD of the existing system.

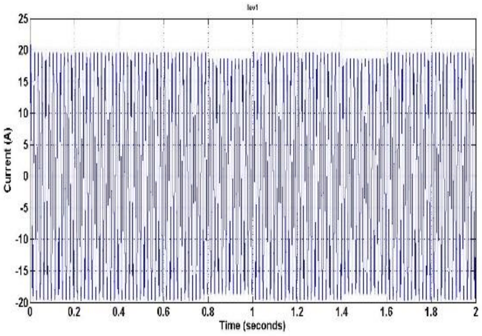
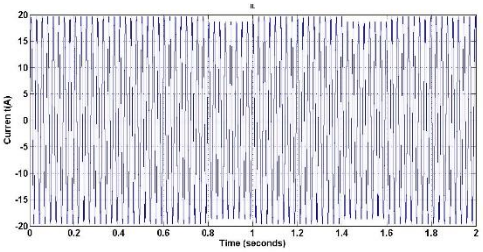
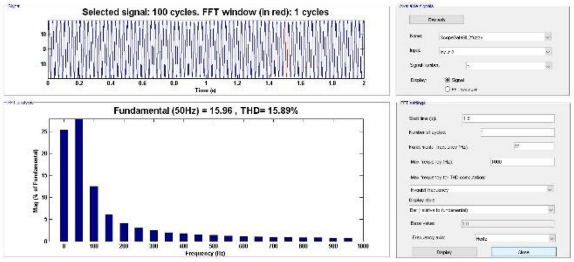


Fig 16 Current of EV1



(a)



(b)

Fig .17 (a) Current at Load & (b) Load current THD%

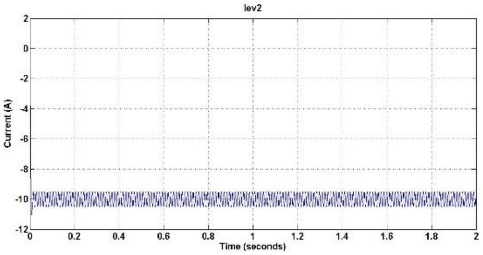


Fig.18 Current of EV2

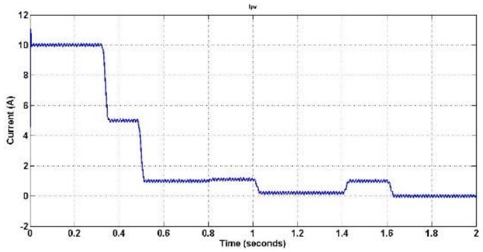


Fig .19 Current (photovoltaic)

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

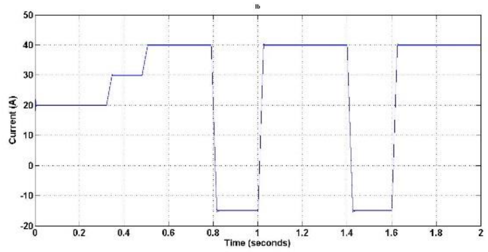
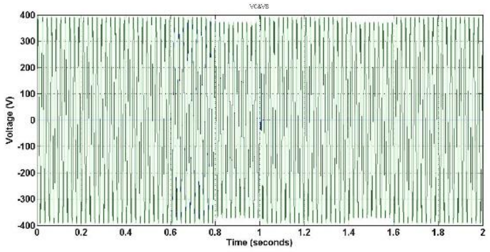
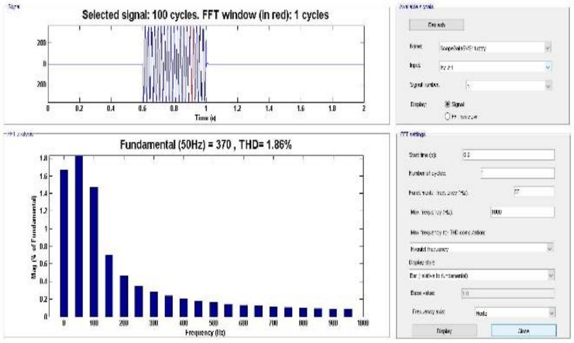


Fig.20 Current (Battery)

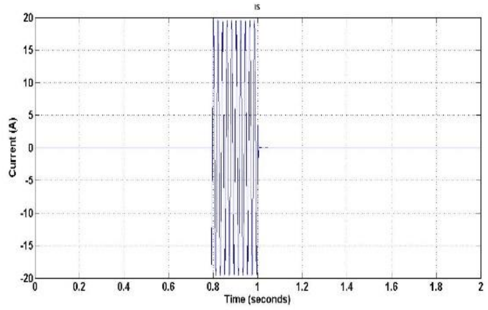


(a)

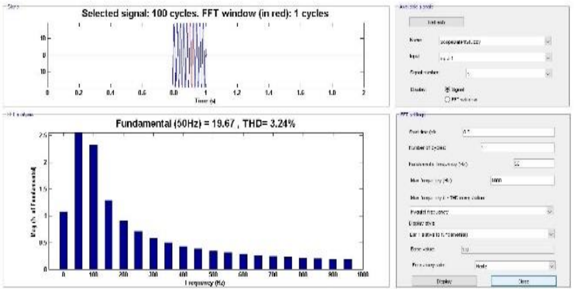


(b)

Fig.21 (a) Voltage at PCC & Voltage at the Grid (b) Grid voltage THD%



(a)



(b)

Fig .22 (a) Current of the Grid (b) Grid current THD%

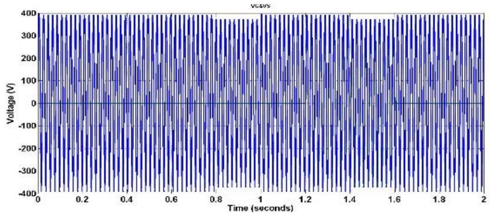
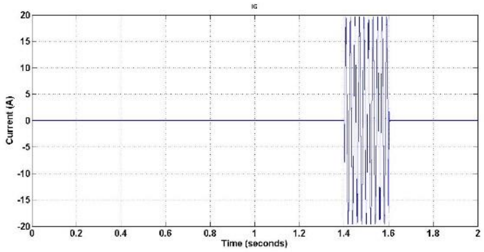
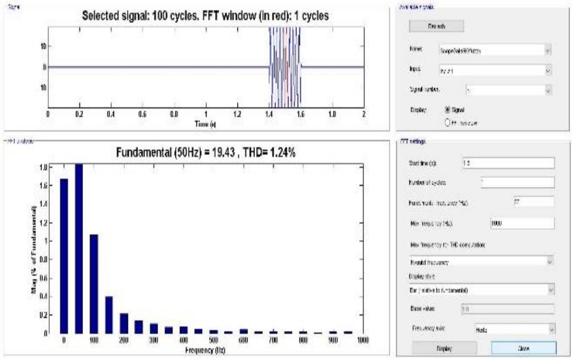


Fig.23 Voltage of generator & voltage at the PCC



(a)



(b)

Fig.24 (a) Current at the Generator & (b) Generator current THD%

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

COMPARISION TABLE

	With PI Controller (THD %)	With FOPID controller (THD %)
VS	**2.57%**	**1.80%**
IS	**4.11%**	**3.24%**
IG	**1.80%**	**1.24%**
IL	**28.02%**	**15.89%**

CONCLUSION

This project proposes implementation of PV array, storage battery, grid and DG set based charging station has been realized for EV charging. The obtainable results have verified the multimode operating capability (islanded operation, grid connected and DG set connected) of the CS using only one VSC. The operation of charging station as a standalone generator with good quality of the voltage, has been verified by the presented results. the islanded operation, grid connected and DG set connected operations along with the FOPID controller and automatic mode switching have increased the probability of MPP operation of the PV array and optimum loading of DG set along with increasing the charging reliability. The IEEE compliance operation of the charging station with voltage and current THD always less than 5% verifies the effectiveness of the control.

REFERENCES

[1] The International Energy Agency forecasts that by 2025, the global fleet of plug-in vehicles will outnumber battery-electric vehicles. [Online] offered: Global EV Outlook 2018

[2]The International Energy Agency (IEA) predicts that by 2018, renewable energy will surpass the world's energy consumption from conventional sources for the first time. [Online]. Currently available:

[3] The authors' optimal capacity sizing for fully green charging systems for electric vehicles is published in the article “Optimal Capacity Sizing for Completely Green Charging Systems for Electric Vehicles,” which is included in IEEE Trans. Transport at. Electrification. vol. 3, no. 3, pp. 565-577, Sept. 2017.

[4]A 10 kW solar-powered bidirectional EV charger compatible with Chemo & COMBO was designed by G. R. Chandra Moulid, J. Schijffelen, M. van den Heave, M. Carolus, & P. Bauer, who call it EV Bidirectional Charge Station (EVBS).

[5]"Modeling, design, control, & implementation of a modified Z-source integrated PV/grid/EV DC charger/inverter,” by S. A. Singh, G. Carli, N. A. Aziz, & S. S. Williamson, IEEE Trans. Ind. Electron., vol. 65, no. 6, pp. 5213-5220, June 2018."

[6]Hybrid optimization was used to optimize the economic deployment of ESS in PV-integrated EV charging stations, as studied by K. Chaudhary, A. Kill, K. N. Kumar, U. Jalandhar, & S. K. Kollimalla, "Hybrid Optimization for Economic Deployment of ESS in PV-Integrated EV Charging Stations," IEEE Trans. Ind. Inform., vol. 14, no. 1, pp. 106-116, Jan. 2018.

[7]Distributed coordination of EV charging with renewable energy in a micro grid of buildings, by Y. Yang, Q. Jian, G. Deconinck, X. Guan, Z. Qiu, & Z. Hu, IEEE Trans. Smart Grid, vol. 9, no. 6, pp. 6253-6264, Nov. 2018.

[8]Loss-of-life investigation of EV batteries used as smart energy storage for commercial building-based solar photovoltaic systems by N. Kandalama, K. Kandalama, & K. Tseng, "Loss-of-life investigation of EV batteries used as smart energy storage for commercial building-based solar photovoltaic systems," IET Electrical Systems in Transportation, vol. 7, no. 3, pp. 223-229, 9 2017.

[9]"Energy exchange between the electric vehicle load & wind-generating utilities was studied by A.

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2017.23.01.011

Tawakoni, M. Negnevitsky, D. T. Nguyen, & K. M. Mutai in IEEE Trans. Power Sys., vol. 31, no. 2, pp. 1248-1258, 2016."

[10]Y. Shan, J. Hu, K. W. Chan, Q. Fu, & J. M. Guerrero, "A new control method for PV-wind-battery micro grids" is described in this paper.

[11]Decentralized charge of electric vehicles (PEVs) to absorb extra wind energy via stochastically staggered dual-tariff systems is discussed in a paper by P. Liu, J. Yu, & E. Mohammed, published in the IET Gene, Trans & Dystric, vol. 12, no. 15, pp. 3655-3665, on August 28, 2018.

[12] “Implementation of Solar PV-Battery & Diesel Generator Based Electric Vehicle Charging Station,” B. Singh, A. Verme, A. Chandra, & K. Al-Haddad (2018) report on an installation of a PV-battery & diesel generator system used for electric vehicle charging.

[13]According to the authors, combining solar photovoltaic with battery might integrate PV to a single-phase grid, as shown in their paper, “Integration of solar photovoltaic with battery to single-phase grid” in IET Generation, Transmission & Distribution, vol. 11, no. 8, pp. 2003-2012, 1 6 2017.

[14]Rami & Doagou-Mojarrad compare two alternative forms of multi-objective power management for micro grids.

[15]O. Erin, N. G. Petrakis, T. D. P. Mendes, & A. G. Bakeries, along with S. Brito & N. Brito — presented a paper on “Smart Household Operation Considering Bi-Directional EV & ESS Utilization by Real-Time Pricing-Based DR.”