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Performance Analysis of Plug-in Electric Vehicle Supported DVR for Power-Quality Improvement and Energy Back-Up Strategy

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Abstract: ***Electric vehicle technology becomes increasingly important as it takes care of the environmental issues related to ICE vehicle and reduces the dependency on fossil fuels. Electric vehicle being greatly dependent on the limited electrical energy provided by a battery, the power flow efficiency is very important in this context. Electric vehicle integration to the distribution grid is increased at a faster rate because it can act as power backup to the grid/local loads reducing the peak load and filling the valley point. Most of software engineers own an Electric Vehicle based on eco-friendly principles. The Batteries in the car are connected to the charging point (or) grid monitoring of State of Charging (SOC) facilities in the parking area of company. When the Renewable power (solar energy) is available, the batteries will be charged to hundred percentage of SOC. Then excess power from PV will connect to load as well as grid. When the electrical power supply cutoff the car batteries will act as a battery bank of UPS and support to the critical load with condition based Allowable SOC. The total capacity of the batteries depends upon the no of cars available at a particular shift in a day. This work proposes the power backup of EV is utilized as an UPS to Software Company as well as used to support the Dynamic Voltage Restorer (DVR) to mitigate the fault occurring in the distribution system. Additionally, the EV supported DVR compensates voltage harmonics, voltage sag-swell, voltage interruptions coming from distribution to enhance power-quality of entire EV system without any additional compensation devices. The entire system is modeled using MATLAB/SIMULINK and the results confer the feasibility of the proposed objective.***

Keywords: Dynamic Voltage Restorer, Electric Vehicle, Faults, Voltage Sag-Swell, Interruptions, Harmonics, Un-interruptible Power Supplies

I. INTRODUCTION

Hybrid Electric Vehicle (HEV) is an emerging technology in the modern world because of the fact that it mitigates environmental pollution and at the same time increases fuel efficiency of the vehicles. Multilevel inverter controls electric drive of HEV of high power and enhances its performance which is the reflection of the fact that it can generate sinusoidal voltages with only fundamental switching frequency and have almost no electromagnetic interference. Compared to conventional vehicles, hybrid electric vehicles (HEVs) are more fuel efficient due to the optimization of the engine operation and recovery of kinetic energy during braking. With the plug-in option (PHEV), the vehicle can be operated on electric-only modes for a driving range of up to 30–60 km. The PHEVs are charged overnight from the electric power grid where energy can be generated from renewable sources such as wind and solar energy and from nuclear energy. Fuel cell vehicles (FCV) use hydrogen as fuel to produce electricity, therefore they are basically emission free [1]. When connected to electric power grid (V2G), the FCV can provide electricity for emergency power backup during a power outage. Due to hydrogen production, storage, and the technical limitations of fuel cells at the present time, FCVs are not available to the general public yet. HEVs are likely to dominate the advanced propulsion in coming years. Hybrid technologies can be used for almost all kinds of fuels and engines. Therefore, it is not a transition technology. In HEVs and FCVs, there are more electrical components used, such as electric machines, power electronic converters, batteries, ultra capacitors, sensors, and microcontrollers. In addition to these electrification components or subsystems, conventional internal combustion engines (ICE), and mechanical and hydraulic systems may still be present. The challenge presented by these advanced propulsion systems include advanced power train components design, such as power electronic converters, electric machines and energy storage; power management; modeling and simulation of the power train system; hybrid control theory and optimization of vehicle control. In any case, substantial reception of PEVs devour high power from the network to charge extensive number of PEVs. It will strain the general existing force system past its ability [2]. The interest for charging system, incorporating charging stations in parking structures also, carports is more basic as the EVs out and about.

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For long detachment laborers, an open charging station may be a fundamental essential to ensure the ability to finish the round trek furthermore, influence it to home. While charging isn't basic, various EV drivers may plug in to condense the charge release cycle and decline battery wear. A deficiency of charging stations may make EVs less supportive and add to expand apprehension bringing about less individuals grasping the usage of electric vehicles.

Also, if charging system is available at work, tinier batteries and along these lines more moderate vehicles are required to address customer's issues [3]. Past the physical nearness of charging stations, a couple of fundamental needs ought to be filled to deal with the expanding interest for charging system, including as far as possible and the electrical circuits that make charging possible [3]. One plan is charging stations that administration diverse vehicle in the interim with a given system. Various parts of the establishment ought to be shared all together for a charging station to truly profit different vehicles at a similar time. The charging system needs to share the interface port by safely stopping to different vehicles immediately, it needs to share the circuit by apportioning the open energy to not over-load the circuit, and it needs to share as far as possible by acutely booking charging keeping in mind the ultimate objective to maintain a key remove from peak use. To deal with this request, an EV charging system has been created that safely increase the amount of EVs that can be related with a circuit by proportioning the power assigned to each EV [4].

Power systems have been encountering great changes in electric power generations, transmissions, and distributions. For electrical load development and higher power transfer in a to a great extent interconnected system prompt perplexing and less secure power system operation. Power system engineers confronting challenges look for answers for work the system in increasingly an adaptable and controllable way. So part of energy storage devices assume critical part as Energy storage seems, by all accounts, to be valuable to utilities since it can decouple the immediate adjusting amongst supply and demand. Accordingly expanded resource usage is permitted, that encourages the renewable sources entrance and enhances the adaptability, unwavering quality and proficiency of the grid long and short-duration voltage variations by sudden increments in loads, for example, blames or short circuits, beginning of motors, or turning on of electric heaters or they are caused by unexpected source impedance is increment, which are caused by a free association. Power quality issues are separated into two classifications voltage quality and frequency quality. Voltage quality issues are connected with voltage sag, voltage swell, under voltage and over voltage while frequency quality issues are connected with harmonics and transients. A standout amongst the most basic power quality issues is voltage sag which is happen because of its usage of voltage sensitive devices [5]. Energy storage devices can be ordered into two different classes, contingent on their application: short term response energy storage devices and long-term response energy storage devices. Short term response energy devices which incorporate flywheel, super capacitor, SMES though long term response energy storage devices incorporate compress air, hydrogen fuel cell, batteries, Redox flow. Here we are more worried with short term response energy devices. For Long and Short-Duration Voltage Variations remuneration, the DVR which goes about as arrangement associated topology is a more practical arrangement [6][7]. All primary AC power sources encounter states of voltage transients amid clearing of faulty load hardware, when high inrush currents are drawn as load gear is placed on the power line, when energy is bolstered back to the power line or amid failure of the power feeder lines.

Expansive negative transients or power dropouts can last as meager as one-half cycle of the primary AC power or insofar as seconds to minutes, before an optional, standby, AC power source can be activated , or notwithstanding for a considerable length of time, where the primary AC power source gear must be adjusted at a remote area . There are two essential classifications of power supplies for critical loads: "Crisis Power with Time Limited Voltage Dropout" where transitory dropouts in the request of seconds or minutes are permitted and "Uninterrupted Power with Controlled Voltage Transients" where the yield voltage is never permitted to stray from a predefined direction band. In the main classification fall correspondence, therapeutic, and mechanical handling load hardware where transient dropouts don't create any breakdowns. In the second classification fall PC correspondence and life bolster applications where flitting power dropouts or out-of-resistance power supply voltages can cause loss of information, wrong in information or loss of life. In software industry the Uninterrupted Power Supply is more important. The proposed system ensures the uninterrupted power to the software company by meeting the demand with PV system as well as Electric vehicle during the interruption in power grid. Supply of power from the Electric Vehicle to grid is known as vehicle to grid technology which is depicted in [8], [9].

II. PLUG-IN ELECTRIC VEHICLE WITH PV

In few cases, makers have proposed embedding a DC/DC battery charger at the dc association of the grid related PV structure. By estimating the power made by the PV and the power demand of the PEV, the control estimation ensures the charging of the PEV battery from the best possible source. In perspective of the inconsistency between the PV control what's more, the store ask for, various possible circumstances are portrayed. In the event that there ought to emerge an event of, the power stream in a PV stopping territory is regulated through a game plan of PC controlled exchanges [10]. PV sheets of different assessments are interfaced with PEV chargers and the power arrange through PC controlled exchanges. Dependent upon the light levels, the exchanges direct the entire PV energy to the PEVs or the grid or both. A couple of PV sheets are interfaced with the dc transport through a course of action of DC/DC converters.

The DC/DC converter splendidly controls the power stream to the PEVs in perspective of a particular preset points of repression of the dc transport voltage. In light of beyond what many would consider possible the imperativeness change unit energizes three way essentialness stream among the power arrange, PV modules and PEVs. The possibility of DC transport hailing has been proposed by a couple of makers to design energy to dc stacks in a micro grid. Possibly several they have extended this plan to charge PEVs in a micro grid area.

The splendid charging station can work in free mode and system related mode. The trading between various modes is energized by the assortment in DC interface voltage levels incited as a result of the adjustment in sun situated protection. In the midst of the season of low sun based protection and zenith stack on course transformer, the controller moves the charging of PEVs to non-top period.

The proposed control figuring is clear as it incorporates only a single parameter i.e. DC associate voltage to bargain with the course of energy stream in the charging station. It empowers the charging of PEVs using slightest imperativeness from the grid with no hostile impacts on the spread transformer. The going with zones clear up the possibility of DC interface voltage recognizing and its application for control and organization of PV controlled charging workplaces. a couple strings of PV sheets interfaced to their own particular DC/DC converters which share a commonplace dc transport. The DC/DC converter plays out the limit of Maximum Power Point Tracking (MPPT) toward energize the operation of PV board and no more extraordinary power point. The essentialness Energy Storage Unit (ESU) is related with the DC transport by implies of a bi-directional DC/DC buck-help converter. The ESU will support the charging of PEVs when there is no power available either from the cross section or the PV [11].

The battery pack in the ESU can be charged either from the lattice in the midst of off zenith hours or from the PV after all the PEVs have been charged in the charging office. DC/DC buck converter related with the dc transport controls the charging of the PEV. The control portrayal showed up for the charging relies upon the essentials for PEVs. Different PEVs can be charged by having separate buck converters presented for each charging point. The charging office is related with the power allocation orchestrate through a DC/AC bi-directionalsystem tied converter. The control unit screens and controls the power stream between the source and PEV. The control unit creates the changing signs to control the distinctive power converters in the charging in light of the voltage and current regards identified by the voltage and current identifying units. VPV, voltage over the PV exhibit and IPV, the present spilling out of the PV bunch are used to execute MPPT by techniques for incremental conductance estimation.

III. DYNAMIC VOLTAGE RESTORER

The series controllers for control of the principal voltage are named as a series connected PWM regulator in, a static series regulator in and, however for the most part the devices are named dynamic voltage restorers. On the off chance that the gadget just injects reactive power the gadget can be named as series var compensators. Taking the same rearranged model of supply and load, yet now with a series controller embedded to support the load. A 0.5pu voltage sag can by a series gadget be reestablished by a 0.5 pu DVR and just 0.5pu of the energy absorbed by the load must be provided by the DVR. The supply keeps on being connected and no resynchronization is essential as it is the situation with a shunt connected converter. The series voltage controller is connected in series with the protected load. Normally the association is made through a transformer, yet designs with coordinate association by means of power electronics likewise exist. The subsequent voltage at the load bus bar squares with the aggregate of the grid voltage and the injected voltage from the DVR. The converter generates the reactive power required while the active power is taken from the energy storage. The energy storage can be unique contingent upon the requirements of compensating. The DVR frequently has impediments on the profundity and duration of the voltage sag that it can adjust. Accordingly right estimated must be utilized as a part of request to accomplish the wanted assurance. Alternatives accessible for energy storage amid voltage sags are regular capacitors for brief duration yet profound, batteries for more however less extreme size drops and super capacitors in the middle. There are additionally different mixes and setups conceivable.

Dynamic Voltage Restorer (DVR) shields the load from voltage disturbances. DVR keeps up the load voltage at a foreordained level amid any source voltage strange conditions, for example, voltage sags/swells or distortion. The working rule of the DVR can be clarified through the figure 1. Under ordinary working conditions, let the three phase voltage phasors Va1, Vb1 and Vc1. Amid anomalous conditions, the phase voltage vectors might be adjusted to Va2, Vb2 and Vc2. DVR does not supply any real power in the relentless state. This infers that the phase angle contrast between DVR voltage phasors also, current phasors must be 90 in the enduring state. DVR injects the required compensating voltage through transformer. The transformer is connected in series to the load. DVR works just amid the irregular conditions and stays sit still amid ordinary working conditions. Amid operation, DVR has an ability to supply and absorb active and reactive power.

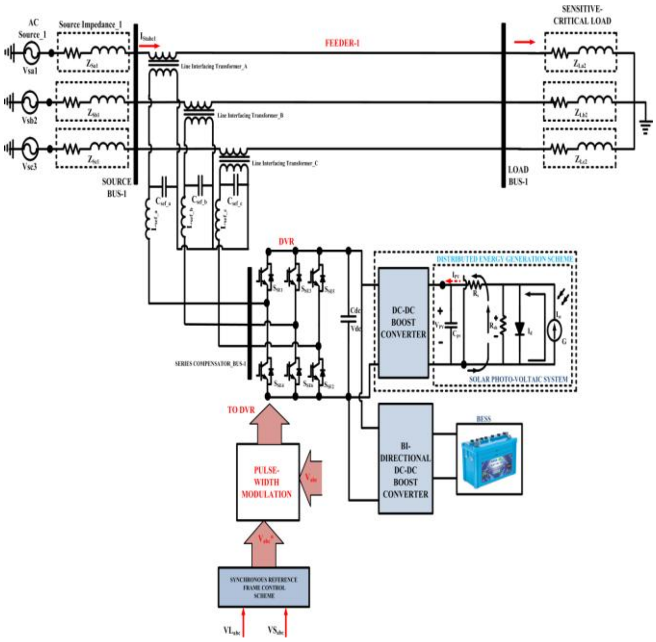

Fig.1 Schematic diagram of DVR Fed SPV-BESS System

Dynamic voltage restorer redresses the load voltage by supplying reactive power created inside other event of small fault. DVR creates active power when it is required to adjust bigger faults. It requires DC energy gadget to build up the active power. As a rule, DC capacitor banks are utilized as the dc energy storage gadget, the proposed system utilizes PV system.

Frequently caused voltage disturbances are voltage sags as they can cause load stumbling. Dynamic Voltage Restorer (DVR) is a series controller connected in series to the load. DVR injects voltage in series to the load through the infusion transformer furthermore, voltage source converter. The infusing transformer injects the required voltage vector (greatness and angle) which adds to the source voltage to reestablish the load voltage to pre-irregular condition.

The series-VSI compensator of DVR device performs as voltage controlled device on PCC regulated at a pre-referred value. The main functions of series-VSI compensator are to compensate the voltage-sag, voltage-swell and voltage-interruptions, voltage harmonics and all voltage-related issues. A well-recognized control scheme is the best selection for superior performance of series-VSI compensator of DVR. The working of series-VSI of DVR greatly depend on analogy of appropriate load voltage with respect to actual line voltage. The attained error quantities are resolved dynamically by differentiating the actual and reference voltage values. The Phase-Locked Loop (PLL) is used to generate the unit-sinusoidal functions which are in-phase with main utility-grid voltage. The actual voltage measured from load-bus of (V_{Labc}) are transformed into *dq* quantities as V_{dq0act} by using Clarke's transformation process.

$$\begin{bmatrix} V_{dact} \\ V_{qact} \\ V_0 \end{bmatrix} = \frac{2}{3}\begin{bmatrix} \cos\theta & \cos[\theta-\frac{2\pi}{3}] & \cos[\theta+\frac{2\pi}{3}] \\ \sin\theta & \sin[\theta-\frac{2\pi}{3}] & \sin[\theta+\frac{2\pi}{3}] \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}\begin{bmatrix} V_{La} \\ V_{Lb} \\ V_{Lc} \end{bmatrix} \tag{1}$$

The "ω" angular velocity and θ is the displacment factor is associated by

$$\theta = \int \omega dt \tag{2}$$

The control scheme of series-VSI of DVR encounters the *abc* to *dq* transformation of reference and actual voltages. During the normal & symmetrical situations, the voltage is sustained constant and the *d*-frame voltage is retained as unity (p.u) and *q*-frame voltage is set as zero (0 p.u). After the transormation process, the outcome voltage like (V_{dqact}) is compared to reference voltages (V_{dqref}). When both the actual and reference voltage vectors are compared and attain some error quantities, these error quantities are minimized by using PI controller. The selection of optimal proportional (k_{pv}) and integral (k_{iv}) gains are evaluated based on trail and error method, the typical transfer function model of PI controller is depicted as below Eqn. (3).

$$U(s) = k_{pv} + \frac{k_{iv}}{s}E(s) \tag{3}$$

Ultimately, the error is counteracted and the outcome values treated as reference voltage generation in *d-q* frame is ($V_{dq}^{\bullet}$). The reference voltage values in *d-q* frame is re-transformed to *abc* frame by using inverse-transformation process as shown in Eqn. (5).

$$V_{dq}^{\bullet} = V_{dqref} - V_{dqact} \tag{4}$$

$$\begin{bmatrix} V_{aref} \\ V_{bref} \\ V_{cref} \end{bmatrix} = \frac{2}{3}\begin{bmatrix} \cos\theta & \sin\theta & 1 \\ \cos[\theta-\frac{2\pi}{3}] & \sin[\theta-\frac{2\pi}{3}] & 1 \\ \cos[\theta+\frac{2\pi}{3}] & \sin[\theta+\frac{2\pi}{3}] & 1 \end{bmatrix}\begin{bmatrix} V_d^{\bullet} \\ V_q^{\bullet} \end{bmatrix} \tag{5}$$

The reference voltage in *abc* frame is V_{abc_ref} is used as reference voltage signal to generate optimal switching states by using sinusoidal PWM scheme. The schematic diagram of series-VSI control scheme of EV-DVR is shown in Fig.2.

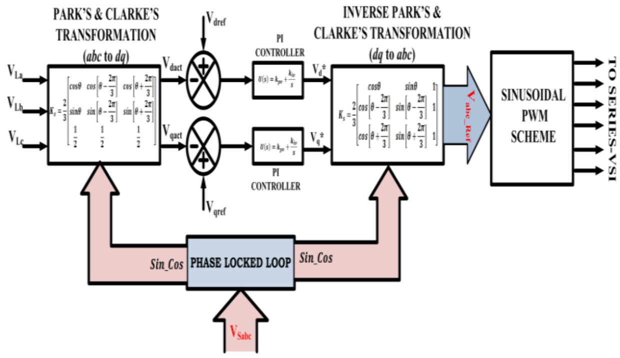

Fig.2 Schematic Diagram of Series-VSI Control Scheme of DVR Device

IV. UPS AND EV SUPPORTED DVR

UPS or an Uninterruptible Power Supply is a device which quickly gives reinforcement power amid power failure. An UPS is regularly utilized for computers or different gadgets, for example, networking gear. This enabled the clients to spare everything to maintain a strategic distance from data loss and appropriately close the PC down. It is extremely an unquestionable requirement to have an UPS for software companies keeping in mind the end goal to forestall downtime. This is likewise used to avoid harms to hardware and gadgets particularly with electric vacillations [12]. This crisis power is relied upon the size of the UPS and its current load. It is very costly also difficult to maintain the batteries of the UPS. It need more space to accommodate the batteries. In order to overcome this issue in proposed system the Electric Vehicles parked in the parking are of the company is used as an UPS during power failure. Most of the employees will own the Electric Vehicle. To charge those vehicles the need of power from will increase. It will produce more stress in grid. To overcome this issue, the alternative source should be used to supply power to charging station. The renewable energy is the great alternative to the conventional energy sources. In proposed system the company owned roof top solar energy is taken to supply the power to its charging station.

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When the company is working with the power from the grid the quality of power is very essential to ensure the safety of the electronic devices and equipment.

Because the electronic components are easily affected by small voltage fluctuations [13]. The faults occurring in the distribution system will fluctuate the voltage.

The voltage is the most common power quality problem in distribution system. To compensate the voltage sag, required amount of voltage should be injected in series with the grid voltage. For this purposes the one of the custom power device Dynamic Voltage Restorer is used in series with the grid which restores the voltage. The DVR need DC energy source or Energy storage device to compensate the voltage fluctuation. The solar PV energy is primary energy source takes it relies on the photo-electric effect to produce the electrical energy. In the dark circumstances of the PV cell is akin of normal diode, when the sun-light energy is higher than the semi-conductor energy gap which provides the cell electrons becomes free and existed current travels through external circuitry. As PV cell has low voltage and more fragile, formed as modules and securing with an enclosed metallic case. Based on the requirement power levels, the PV cells are integrated as series and/or parallel to form as solar PV-array. The mathematical model of the PV cell is extracted by single-diode model as depicted in Fig.3. The outcome of the PV cell resulted based on the physical attraction of the PV cell is relating with the I_{sv}, I_{phv}, R_{sv}, from the irradiation & temperature over the other.

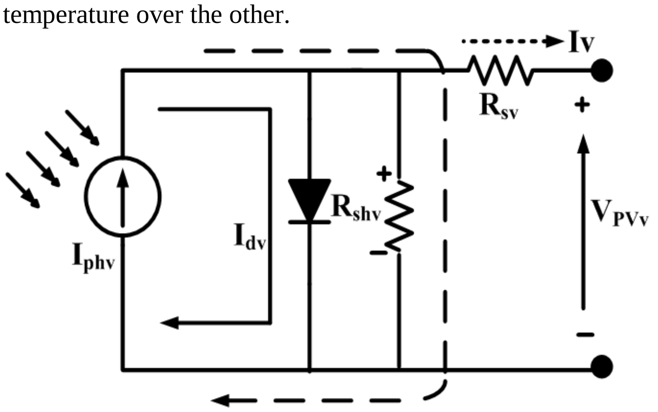


Fig.3 Mathematical model of Solar PV System

$$Iv = I_{phv} - (I_{sv}[\exp q\frac{V_{PVv} + R_{sv}Iv}{NKT}] - 1) - \left[\frac{V_{PVv} + R_{sv}Iv}{R_{shv}}\right] \qquad (6)$$

The Equation (6) illustrates the current equation of PV cell, Where,

I_{phv} - Photovoltaic current in amps (A)

I_{sv} - Diode's reverse saturation current in amps (A)

q - Electron charge

V_{PVv} - Terminal voltage of the diode in volts (V)

K - Boltzmann's constant value

T - Junction wise temperature

N - Ideality index factor of diode

R_{shv} - Shunt resistance of PV cell in ohms (Ω)

R_{sv} -Series resistance of PV cell in ohms (Ω)

V. MATLAB/SIMULINK RESULTS

The performance of proposed EV system is verified under various voltage-related PQ issues by using proposed DVR by utilizing MATLAB/SIMULINK tool with operating specifications as depicted in Table.1.

Table.1 Operational Parameters of Proposed DVR

Parameters	Values
Source Voltage	415 V, 50Hz
Source Impedance	0.1+j0.05Ω
Load Impedance	10+j15Ω
DC-Link Capacitor	1500µF
VSI Filter Units	R-1; L-5mH
PI Controller Gains	Kp-1; K-0.1
Solar-PV System	200V-400V
DC-DC Converter	Vdc-400V-800V

Case A: Performance of EV System by Using BESS/Solar-PV Powered Vehicle

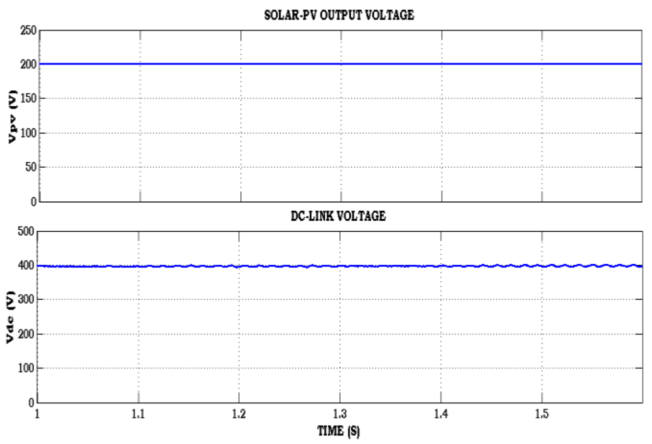


Fig.4 Solar PV Voltage & DC-Link Voltage

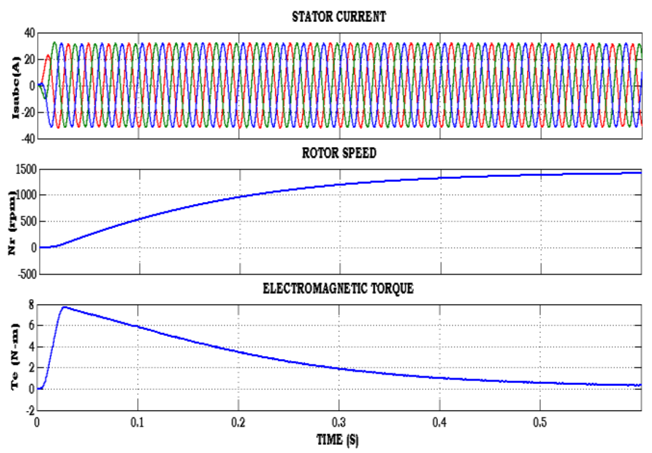


Fig.5 EV System Results

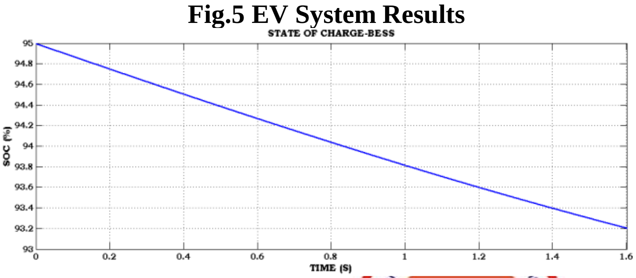


Fig.6 BESS-State of Charge

The simulation results of EV system under powered by Solar-PV/BESS system by using VSI topology. The solar-PV array generates 200V DC energy which is retransformed into pure DC by using DC-DC converter as depicted in Fig.4. The performance of induction motor in EV attains sinusoidal stator currents, constant speed, attains required torque for driving the vehicle as depicted in Fig.5, and the state of charge of BESS is depicted in Fig.6 represented as decreasing state with a 95% to 93%.

Case B: Performance of DVR System by Series-VSI of EV System under various PQ issues

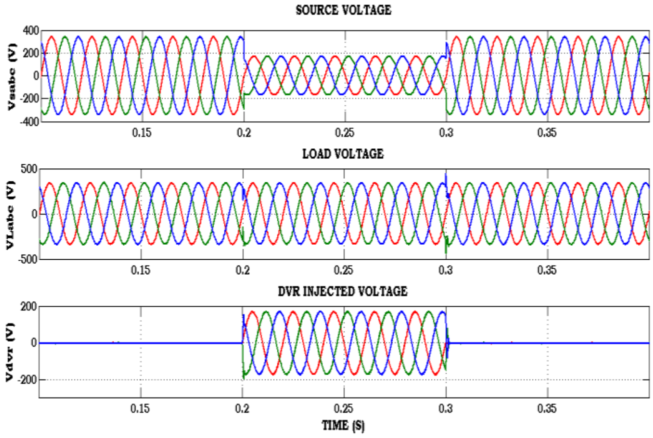


Fig.7 Simulation Results of DVR during Voltage-Sag Condition

The simulation results of DVR during voltage-sag condition which is compensated by Solar-PV/BESS with the help of VSI topology in distribution system. The source voltage is acquired from grid system with a voltage of 415V, 50Hz RMS quantities are affected by various voltage-related PQ issues. In this context, voltage sag is appeared at an instant of t-0.2 sec to 0.3 sec which results the affect of load voltage. At this instant series-VSI of DVR is activated and compensates voltage through injection transformers and maintains load voltage as constant as shown in Fig.7.

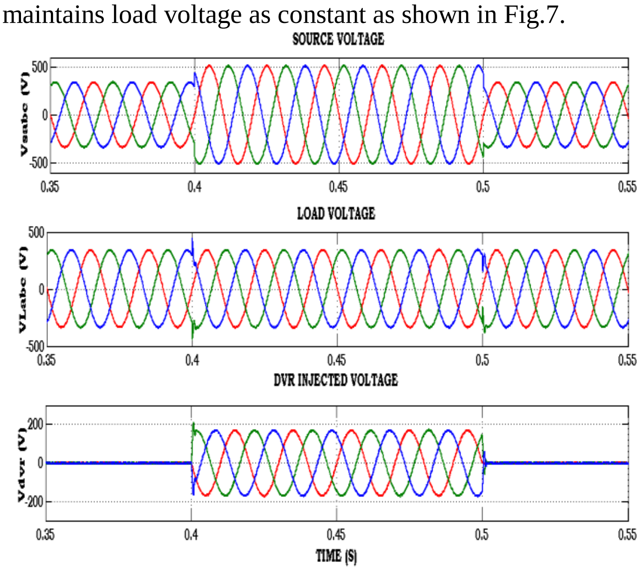


Fig.8 Simulation Results of DVR during Voltage-Swell Condition

The simulation results of DVR during voltage-swell condition which is compensated by Solar-PV/BESS with the help of VSI topology in distribution system. The source voltage is acquired from grid system with a voltage of 415V, 50Hz RMS quantities are affected by various voltage-related PQ issues. In this context, voltage swell is appeared at an instant of t-0.4 sec to 0.5 sec which results the effect of load voltage. At this instant series-VSI of DVR is activated and compensates voltage through injection transformers and maintains load voltage as constant as shown in Fig.8.

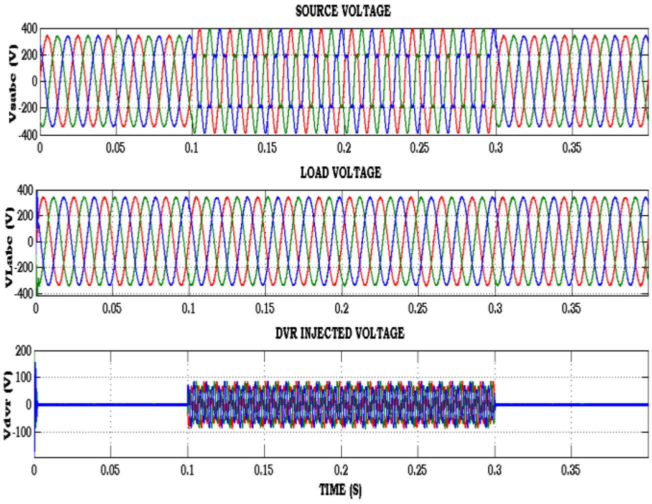


Fig.9 Simulation Results of DVR during Voltage-Harmonics Condition

The simulation results of DVR during voltage-harmonics condition which is compensated by Solar-PV/BESS with the help of VSI topology in distribution system. The source voltage is acquired from grid system with a voltage of 415V, 50Hz RMS quantities affected by various voltage-related PQ issues. In this context, voltage harmonics are appeared at an instant of t-0.1 sec to 0.3 sec which results the effect of load voltage as high harmonic distortions.

At this instant series-VSI of DVR is activated and compensates voltage through injection transformers and maintains load voltage as sinusoidal, balanced and constant as shown in Fig.9.

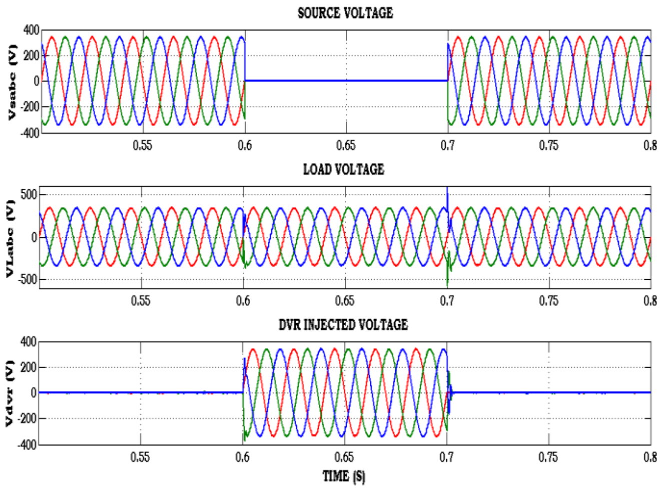


Fig.10 Simulation Results of DVR during Voltage-Interruptions Condition

The simulation results of DVR during voltage-interruptions condition which is compensated by Solar-PV/BESS with the help of VSI topology in distribution system. The source voltage is acquired from grid system with a voltage of 415V, 50Hz RMS quantities affected by various voltage-related PQ issues. In this context, voltage interruptions are appeared at an instant of t-0.6 sec to 0.7 sec which results load voltage as zero. At this instant series-VSI of DVR is activated and compensates required load voltage through injection transformers and maintains load voltage as constant as shown in Fig.10.

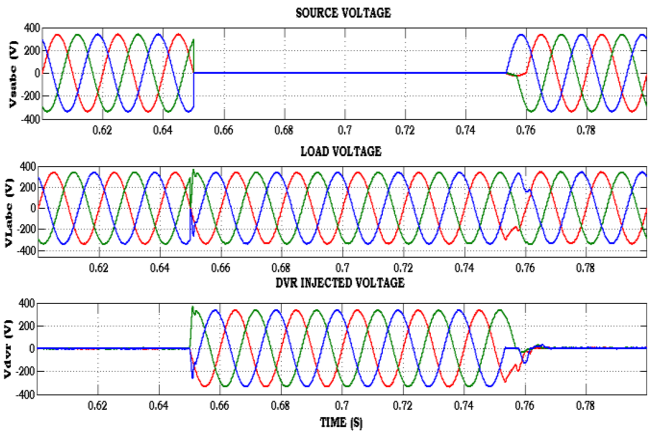
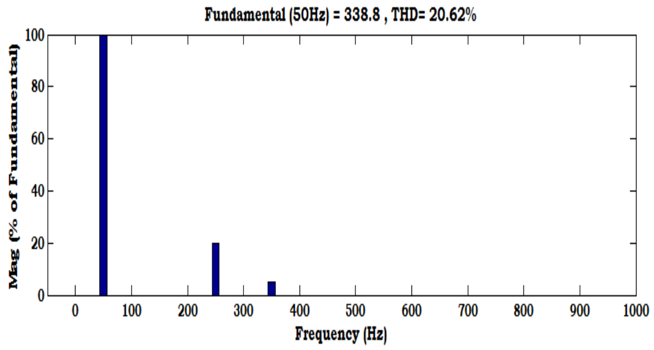
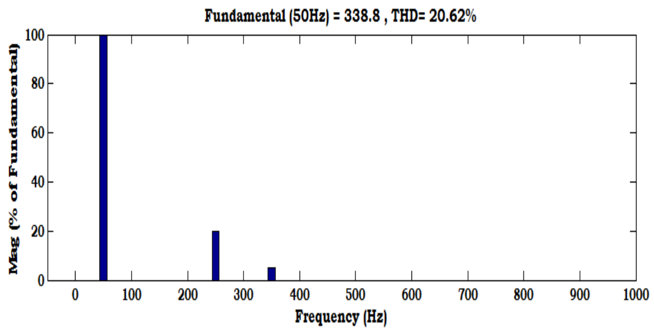


Fig.11 Simulation Results of DVR during Fault Condition



(a) THD analysis of Source Voltage



(b) THD analysis of Load Voltage

Fig.12THD Analysis of Source and Load Voltage during Voltage Compensation through DVR

The simulation results of DVR during fault condition which is compensated by Solar-PV/BESS with the help of VSI topology in distribution system. The source voltage is acquired from grid system with a voltage of 415V, 50Hz RMS quantities affected by various voltage-related PQ issues. In this context, fault condition is appeared at an instant of t-0.65 sec to 0.75 sec which results load voltage as affected. At this instant series-VSI of DVR is activated and compensates required load voltage through injection transformers and maintains load voltage as constant as shown in Fig.11. The THD analysis of source voltage during without compensation is 20.62% and with compensation through DVR is 0.03%, which is comply with IEEE-519/1992 standards as depicted in Fig.12.

VI. CONCLUSION

Recently, eco-friendly cars such as Electric Vehicles, Hybrid Electric Vehicles or Plug in Hybrid Electric Vehicles are attracting increasing attention as a solution of environmental pollution, global warming and exhaustion of fossil fuels. The multipurpose use of the power electronic converter in the drive train of an electric vehicle has become an interesting topic for minimizing the system size, weight, and cost. The weight and size of the converter are challenging issues in the case of on-board chargers which otherwise provides the flexibility of charging/discharging the vehicle anywhere. It is used as an UPS to reduce the maintenance and cost barrier of the software company with conventional batteries. For the emerging EVs the charging station is one of the issues. It can overcome with the renewable energy source as power supply to the station. In proposed system PV is used as a power supply to the charging station. The quality of the power is endured with the Electric Vehicle supported Dynamic Voltage Restorer. Thus the proposed system was analyzed in MATLB/ SIMULINK software.

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