INTERNATIONAL JOURNAL
OF TECHO-ENGINEERING

ISSN : 2057-5688

ELECTRIC VEHICLE CHARGE–DISCHARGE MANAGEMENT FOR UTILIZATION OF PHOTOVOLTAIC BY COORDINATION BETWEEN HOME AND GRID ENERGY MANAGEMENT SYSTEMS

[1] S RESHMA, [2] M.SAI VYSHNAVI, [3] K.DIWAKAR, [4] A.BALAJI, [5] B.S.FAYAZ BASHA, [6]G.C.YUDHISTAR

[1] Assistant Professor, Dept of EEE, Gates institute of technology, Gootyanantapuram, Peddavadugur, Anantapuram, AP,India.

[2,3,4,5,6] UG Students, Dept of EEE, Gates institute of technology, Gootyanantapuram, Peddavadugur, Anantapuram,, AP,India.

Abstract:

This paper proposes an electric vehicle (EV) charge-discharge management framework for the effective utilization of photovoltaic (PV) with Wind power output through coordination based on information exchange between home energy management system (HEMS) and grid energy management system (GEMS). In our proposed framework, the HEMS determines an EV charge discharge plan for reducing the residential operation cost and PV With wind curtailment without disturbing EV usage for driving, on the basis of voltage constraint information in the grid provided by the GEMS and forecasted power profiles. Then, the HEMS controls the EV charge-discharge according to the determined plan and real-time monitored data, which is utilized for mitigating the negative effect caused by forecast errors of power profiles. The proposed framework was evaluated on the basis of the Japanese distribution system simulation model. The simulation results show the effectiveness of our proposed framework from the viewpoint of reduction of the residential operation cost and PV curtailment.

Keywords: BESS, Circuit breaker, switch off time period, ESS.

1. Introduction:

Reduction of CO2 emissions to prevent global warming is a worldwide challenge. Electricity will account for almost a quarter of the final energy consumption by 2040 [1]; the power sector is needed to lead the way toward a decarbonizes energy system. In Japan, in addition to CO2 emissions, primary energy self-sufficiency is a large issue. Energy self sufficiency has stayed at only 6% after the Great East Japan earthquake and the Fukushima Daiichi accident in 2011. In order to break down this emergency, the government is aiming to increase it to approximately 25% by 2030 [2]. On the other hand, the amount of CO2 emissions was 201 million only in the household sector in 2013, and the aim is to reduce this volume by 39.3% by 2030 [3]. To overcome these energy issues, the government is developing newly constructed houses with zero average emissions for deployment by 2030, so-called net-zero energy houses (ZEHs), which have an annual net energy consumption of zero or less, is receiving considerable attention [4]. To achieve

ZEHs, utilization of residential photovoltaic (PV) systems is essential; besides, the energy storage systems should be deployed in households to flexibly utilize electricity from the PV systems. Additionally, home energy management system (HEMS) is expected to become an important component in realizing ZEH in Japan, and could be introduced in all (approximately 50 million) households by 2030 [2]. Electric vehicles (EVs) can be used for energy storage to effectively utilize PV, while it is originally used for driving. Connecting EVs to the power grid with renewable energy sources (RESs) will lead to various cost advantages [5] in terms of energy management, but the power flow tends to be complicated; the power flow derived from EVs has large and temporally unexpected variation compared with conventional flows. Therefore, in the energy management of EVs, the impact of EV charge-discharge on the grid must be addressed, along with the effective utilization of RESs. There are many previous studies on EV charge-discharge Management.

When EV charged, SMES will mitigate the secondary side voltage fluctuation of the transformer caused by the fault or variable load on the grid. Due to the burden of the power supply, increases the usage of renewable energy resources such as photovoltaic power plant. By using SMES system the load curve, diminishing the voltage fluctuation, increasing the power quality and stability. SMES is an outstanding power compensator, will provide active and reactive power with very quick response in order to compensate the voltage in the EV charging stations. Since EV introduce uncertainty in charging or discharging state, smart grid with EV face much more complicated situation. Nowadays several fault is occur in metropolitan area especially during thunderstorm, the transient stability must be essential. So the dynamic performance analyzed under balanced fault such as three phase to ground fault.

2. RELATED STUDY:

SMES is initially conceived as load leveling devices that is it is used to store energy in bulk and also to smoothening the utility's daily peak demand. In SMES, the electricity is stored by circulating a current in a superconducting coil. Because of no conversion of energy to other forms is involved, its efficiency is very high. SMES can respond very rapidly to absorb or receive power from the grid/load. Because of its fast response, SMES can provide benefit to a utility not just as a load-leveling device, but also for enhancing transmission line stability and power quality. So SMES can be viewed as a Flexible Transmission system (FACTs) SMES applications in Transmission Substation are; Transmission Stability, Voltage/VAR Support. Load Leveling. SMES applications in Generation System are; Frequency Control, Spinning Reserve, Dynamic Response The basic principle of SMES is to store energy in the magnetic field generated by a dc current flowing through the coiled wire. Magnetic field produces heat when normal wire is used for wounding the coil. The coil is a DC device, the charge and discharge are usually done through an AC utility grid, so a power conditioning system (PCS) is required as the interface. PCS can use a standard solid state DC/AC converter for transferring the power back and forth between the superconducting coil and load/grid. The PCS interfaces the superconducting magnet(DC) with the utility grid(AC).The DC/AC conversion is done using through inverter/rectifier composed of SCR and GTO arrangement with a specified duty cycle. The losses in PCS during idling and conversion are important for determining the plant efficiency. SMES system shows the difference depending upon the size and duty cycle. The core of the SMES is High Temperature Superconducting coil (HTS).Depending upon the size of application, the coil may be solenoid or toroid. Solenoid coil are much more cost effective for large SMES system.

Consequently, the battery may still experience the high-frequency power fluctuations which result in stinging charge/discharge of the battery. A modified fraction control method is, therefore, developed to share the power between the SMES and the battery. In the new method, the SMES and the battery are in series position, and the power disturbances are firstly dealt by the SMES. The battery works as the energy buffer to maintain the SMES current. Hence, the battery charges and discharges according to the SMES current rather than the instantaneous net power. The experiment shows that compared with the preceding fraction based HESS control, the new control scheme is able to protect the battery from abrupt power changes.

3. PROPOSED SYSTEM:

We consider two energy management systems (EMSs), i.e., HEMS, which is composed of a rooftop PV, an EV, and a HEMS controller, and GEMS, which is composed of an on-load tap changer (OLTC) and a GEMS controller. Each EMS controller has automated control of its components, i.e., the EMS controllers can change the parameters of components at pre-set times. In general, these two EMSs is independently operated to meet their own requirements. Minimizing the residential operation cost while securing the EV usage for driving is an important requirement for the HEMS. To minimize the residential operation cost, the HEMS controller will charge the EV when the PV is not generating and discharge it to cover the residential electricity consumption when the PV is generating, selling as much surplus PV output as possible. However, such operations increase the reverse power flow which causes overvoltage in the DS, so that the PV inverter tend to curtail the PV output and expected power sales profit could not be obtained;

the residential operation cost will increase. Meanwhile, maintaining the power quality in the power grid is a task for the GEMS. In the DS, the OLTC is widely deployed to maintain the voltage within the acceptable range. Note that increase of available PV output leads to cost reduction for the GEMS because the power source with high fuel cost will be replaced by PV. Therefore, the reduction of PV curtailment is a common profit for the GEMS and HEMS, and there is potential to expand the mutual profit by coordinating the two EMSs. In this section, we explain our proposed coordinated framework of the EV charge-discharge management for reduction of residential operation cost and PV curtailment by effectively charging the expected PV curtailment to the EV. Our proposed framework, shown in Fig. 1, works according to a similar timeline proposed in [26], though it is especially focused on the EV operation. It starts with forecasting residential power profiles, which is composed of residential electricity consumption and PV output for the forthcoming period from 6:00 to 6:00 on the next day. Then, in the operational plan phase, the coordination between the HEMS and GEMS is conducted by the information exchange. The HEMS determines an EV charge-discharge plan for minimizing the residential operation cost on the basis of the forecasted PV output and expected PV curtailment due to the voltage constraint informed from the GEMS. The planned charge-discharge amount would be larger or smaller than the ideal amount for achieving the objectives when the forecasted PV output includes significant error. Hence, in the control phase, the EV charge-discharge is controlled to follow the real-time monitored data in addition to the determined plan (hereinafter called “following control”). The following control intends to mitigate the deficiency and excess of charge-discharge amount caused by the difference between the forecasted and actual profiles so as to avoid unnecessary electricity purchase and opportunity loss of surplus PV selling. The rest of this section explains the detailed procedures after the HEMS finishes forecasting the day-ahead power profiles.

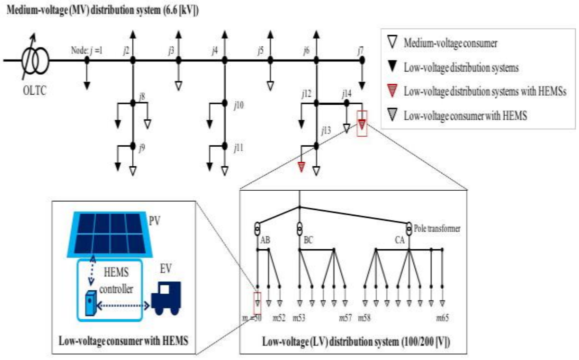

Fig.3.1. Proposed model.

4. SIMULATION RESULTS:

Let $n \in N$ be the index of house without HEMS where N be the index set of the houses without HEMSs. The appropriate voltage control parameter set of the OLTC are determined using the forecasted power profiles and the EV provisional plan $xG = \{xPV\ m, xr\ m, ym ; m \in M\} \cup \{xPV\ n, xr\ n ; \in N\}$ and the EV provisional plans sent from the HEMSs y are evaluated under the voltage constraint. Our grid management is carried out by the GEMS composed of a GEMS controller and an OLTC. The tap ratio of the OLTC is regulated using the line drop compensator (LDC) method [27] so as to maintain the voltage in the DS. In this method, the OLTC monitors its secondary current and voltage to dynamically control the tap position. Let *it* and ˙*vt* be the secondary current and voltage of the OLTC, respectively.

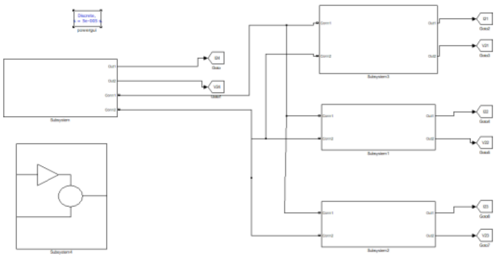

Fig.4.1. Simulation Circuit.

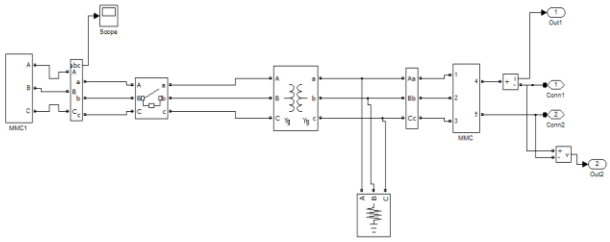

Fig.4.2. Generating station Simulation circuit.

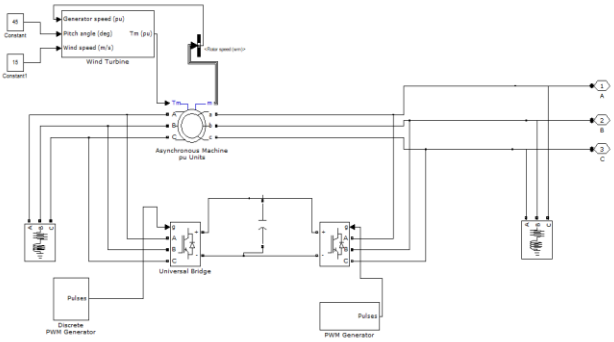

Fig.4.3. Wind power generation circuit.

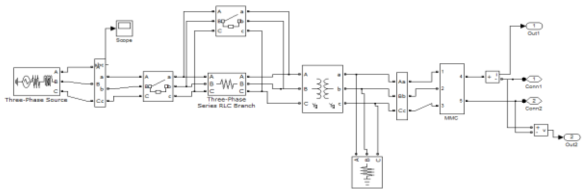

Fig.4.4. Subsystem circuit with phase voltage circuit.

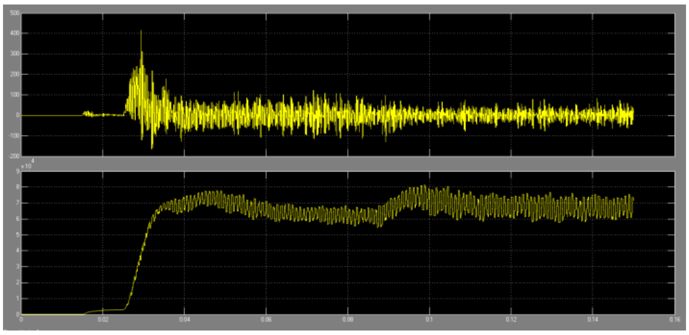

Fig.4.5. Voltage and current across the Subsystem.

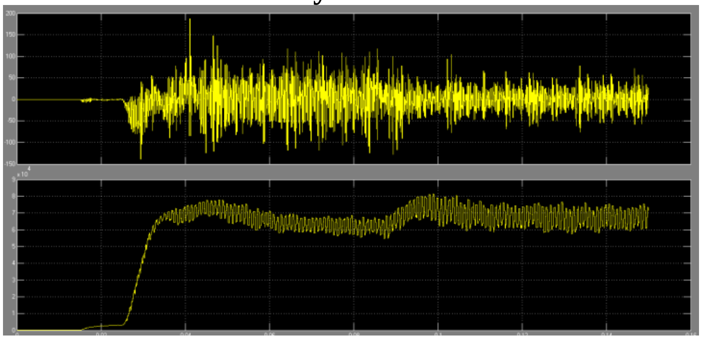

Fig.4.6. Output voltage across the subsystem 2.

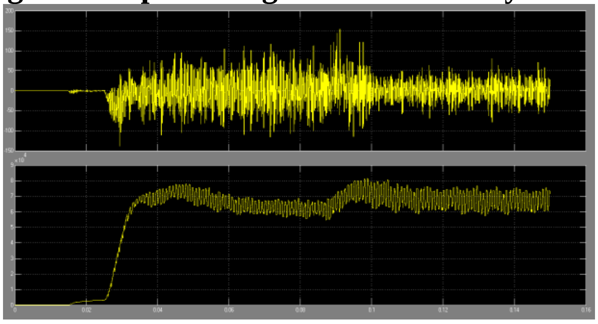

Fig.4.7. Output voltage across the subsystem 3.

5. CONCLUSION:

We proposed a coordinated EV charge discharge management framework. The coordination is based on the information exchange between the HEMS and GEMS. The proposed framework determines a daily EV charge-discharge plan on the basis of the exchanged information and day-ahead forecasted power profiles to ensure the adequate free capacity for charging the curtailed PV during the daytime and the charged capacity for the scheduled EV drive. We also proposed a following control scheme. The scheme controls the EV charge-discharge amount following to the realtime monitored data for mitigation of the deficiency and excess of charge-discharge amount caused by the forecast errors. The effectiveness of the proposed framework was evaluated using a DS simulation model from the viewpoint of the residential operation cost and the amount of PV curtailment. The simulation results implied that the proposed framework achieves to reduce the residential operation cost and the PV curtailment by the information exchange and the following control.

REFERENCES:

[1] K. T. Chau and C. C. Chan, "Emerging energy-efficient technologies for hybrid electric vehicles," *Proc. IEEE*, vol. 95, no. 4, pp. 821–835, Apr. 2007.

[2] S. P. Richardson, D. Flynn, and A. Keane, "Optimal charging of electric vehicles in low-voltage distribution systems," *IEEE Trans. Power. Syst.*, vol. 27, no. 1, pp. 268–279, Feb. 2012.

[3] K. Qian, C. Zhou, M. Allan, and Y. Yuan, "Modeling of load demand due to EV battery charging in distribution systems," *IEEE Trans. Power. Syst.*, vol. 26, no. 2, pp. 802–810, May 2011.

[4] P. Zhang, K. Qian, C. Zhou, B. G. Stewart, and D. M. Hepburn, "A methodology for optimization of power systems demand due to electric vehicle charging load," *IEEE Trans. Power. Syst.*, vol. 27, no. 3, pp. 1628– 1636, Aug. 2012.

[5] K. Clement-Nyns, E. Haesen, and J. Driesen, "The impact of charging plug-in hybrid electric vehicles on a residential distribution grid," *IEEE Trans. Power Syst.*, vol. 25, no. 1, pp. 371–380, Feb. 2010.

[6] J. X. Jin and X. Y. Chen, "Study on the SMES application solutions for smart grid," *Physics Procedia*, vol. 36, pp. 902–907, 2012.

[7] C. A. Luongo, "Superconducting storage systems: An overview," *IEEE Trans. Magn.*, vol. 31, no. 4, pp. 2214–2223, Jul. 1996.

[8] S. Kolluri, "Application of distributed superconducting magnetic energy storage system (D-SMES) in the entergy system to improve voltage stability," in *Proc. IEEE Power Eng. Soc. Winter Meet.*, 2002, vol. 2, pp. 838– 841.

[9] H. A. Peterson, N. Mohan, and R. W. Boom, "Superconductive energy storage inductor-converter units for power systems," *IEEE Trans. Power App. Syst.*, vol. PAS-94, no. 4, pp. 1337–1346, Jul. 1975.

[10] M. V. Aware and D. Sutanto, "SMES for protection of distributed critical loads," *IEEE Trans. Power Del.*, vol. 19, no. 3, pp. 1267–1275, Jul. 2004.