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Charging Power Station for Electric Vehicles

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ABSTRACT **- Charging infrastructure for electric vehicles (EV) will be the key factor for ensuring a smooth transition to mobility. Battery powered electric vehicles are gaining popularity worldwide. This is trend is driven by several factors including the need to reduce air and noise pollution, and dependence on fossil fuels. The main drawback of today's electric vehicle is its limited range, and the long time duration that is required to charge the electric batteries. In recent years, significant progress (through research and development) has been made to accelerate the charging time of the electric vehicle batteries through pulse charging rather than supplying continuous current and/or voltage. This paper is about the potential need for electric vehicles (EV) charging station (CS) infrastructure and its challenges for the Indian scenario. This paper presents the scenario about charging power station. The concern is about fast charging of electric vehicle batteries by using advance technologies like pulse charging method. Pulse-based charging method might be efficient way to overcome the shortcoming of slow charging time. The part to be focused on estimation of electrical parameters of the battery in the electrical vehicle, which is the most important factor to get information about possible available driving range. If the amount of remaining battery capacity can be displayed for the driver then it is possible to make decision on the time of recharging the battery. To know battery behavior under different conditions, it is necessary to know various battery performance parameters.**

Keywords: Electric Vehicle, Battery management Pulse charging, Solar PV

I. INTRODUCTION

Recently, electric vehicles (EVs) have grown rapidly as demanded green energy from the world. More specially, in a large city, air pollution due to CO2 emission is a concerned issue. Therefore, higher number of EV s will be used in the next few years. It is expected that more than 5 million EV s will be utilized by 2020 [1]. Generally, EVs can run for 100 km, so a charging station is required as a gas station. There are three important issues for a charging station: quick charge (less than 30 minutes), long battery lifetime (low temperature rise during charge), and standardization (all vehicle providers can be used). So there is concern about usage of renewable energy sources. Recently government of India, is taking initiative for electric vehicles and charging power station based on renewable sources. National governments are focusing on R&D and consumer incentives. By using renewable sources, like solar energy, wind energy, etc. we are presenting idea of charging station. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio.

II. CHARGING METHODS

Constant current (CC) and constant voltage (CV) method are normally used for a battery charger. CC provides shorter time for charging a battery with higher temperature rise; whereas, CV offers low temperature rise with longer charging time. With the limit of voltage per cell (V I*cell*) and maximum charging current (Imax) from battery providers, CC and CV method cannot meet the 30 minutes charging time and low temperature rise requirements from EV users. Thereupon, a pulse charging method is an alternative technique for a quick charger at high current. A pulse charge method can be injected higher peak voltage and current with the same of V I*cell* and I*max* rated; therefore, a charging time is shorter comparing to CC and CV method [2]. There are some previous researches using pulse charge technique for a charger application. Designs of battery pulse charge have been proposed. The proposed method has been designed for a small LiIon battery and could be applied for an EV battery. However, the temperature rise and the effect of frequency and duty cycle of pulse signal did not investigate.

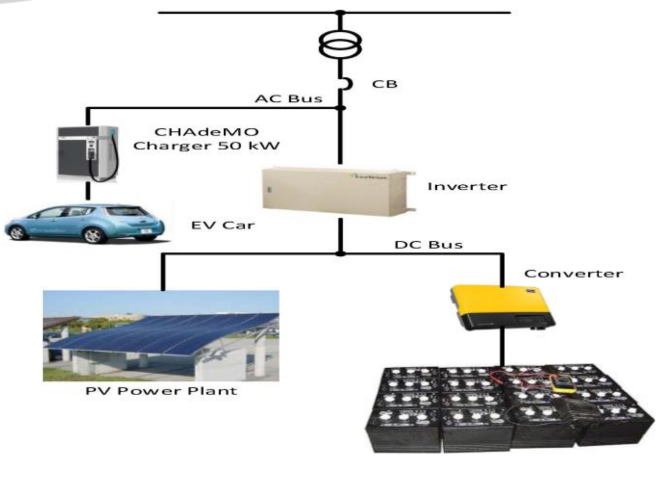

Fig. 1 Quick charging station for EVs.

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III. DESIGN & OVERVIEW

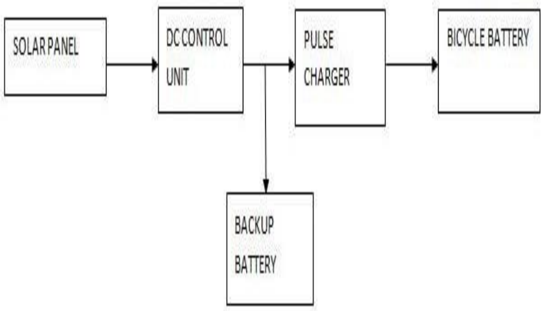

Fig.2. Block diagram of charging station

Solar panel :- Photovoltaic energy generation is recognized as an important part of future energy generation. Because it is non polluting, free in its availability & is of high reliability. Therefore, these facts make the pv energy resources attractive for many applications like charging stations for electric vehicles. We are using the solar power system for purpose of charging power station of electric vehicles. So the design will be dependent on the load i.e. battery of veichles. So for batteries of same ratings the solar panels has to be designed.

DC Control unit :- The charge controller is switching device that can connect and disconnect the charger to the battery and it will take controller over the charging and to stop charging and correct voltage. This will protect the battery from damage from over charging and regulate the power going from solar panal to the battery. Micro-controller in the circuit will read the level of the battery and the cut of the source of the solar panel to the battery, Once it sees the battery is at fully charged state. If this was not in place, the solar panel would keep feeding the batteries energies and batteries would become overheated and damage the internal component.

Backup battery :- Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. As they are inexpensive compared to newer technologies, lead– acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities.

Bicycle battery :- A Li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of a lithium-ion battery cell.

IV. DESIGN OF SYSTEM

Solar PV system sizing:

Determine power consumption demands. The first step in designing a solar PV system is to find out the total power and energy consumption of all loads that need to be supplied by the solar PV system as follows:

A. Calculate total Watt-hours per day for each appliance. Add the Watt-hours needed for all appliances together to get the total Watt- hours per day which must be delivered to the appliance.

B. Calculate total Watt-hours per day needed from the PV modules. Multiply the total appliances Watt-hours per day times 1.3 (the energy lost in the system) to get the total Watt-hours per day which must be provided by the panels.

- Size the PV modules
- Different size of PV modules will produce different amount of power. To find out the sizing of PV module, the total peak watt produced needs. The peak watt (Wp) produced depends on size of the PV module and climate of site location. We have to consider "panel generation factor" which is different in each site location. For Thailand, the panel generation factor is 3.43. To determine the sizing of PV modules, calculate as follows: A. Calculate the total Watt-peak rating needed for PV modules Divide the total Watt-hours per day needed from the PV modules (from item 1.2) by 3.43 to get the total Watt-peak rating needed for the PV panels needed to operate the appliances.
- Result of the calculation is the minimum number of PV panels. If more PV modules are installed, the system will perform better and battery life will be improved. If fewer PV modules are used, the system may not work at all during cloudy periods and battery life will be shortened.
- Battery sizing
- The battery type recommended for using in solar PV system is deep cycle battery. Deep cycle battery is specifically designed for to be discharged to low energy level and rapid recharged or cycle charged and discharged day after day for years. The battery should be large enough to store sufficient energy to operate the appliances at night and cloudy days. To find out the size of battery, calculate as follows:
- Calculate total Watt-hours per day used by appliances. Divide the total Watt-hours per day used by 0.85 for battery loss. Divide the answer obtained in item 4.2 by 0.6 for depth of discharge. Divide the answer obtained in item 4.3 by the nominal battery voltage. Multiply the answer obtained in item 4.4 with days of autonomy (the number of days that you need the system to operate when there is no power produced by PV panels) to get the required . Ampere-hour capacity of deep-cycle battery. with days of autonomy (the number of days that you need the system to operate when there is no power produced by PV panels) to get the required . Ampere-hour capacity of deep-cycle battery.

Battery capacity =Total watt hours per day used by load *days of autonomy/ 0.85*0.6*nominal battery vtg

- Solar charge controller sizing
- The solar charge controller is typically rated against Amperage and Voltage capacities. Select the solar charge controller to match the voltage of PV array and batteries and then identify which type of solar charge

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controller is right for your application. Make sure that solar charge controller has enough capacity to handle the current from PV array.

- For the series charge controller type, the sizing of controller depends on the total PV input current which is delivered to the controller and also depends on PV panel configuration (series or parallel configuration).
- According to standard practice, the sizing of solar charge controller is to take the short circuit current (Isc) of the PV array, and multiply it by 1.3
- Solar charge controller rating = Total short circuit current of PV array x 1.3.

Design of solar panels:

PV system design:-To design stand alone pv system for considered load battery i.e. battery rating of electric vehicles, the following steps are required:-

Step.1: Average daily solar input:-

G(avg)= 5.32 kWh/m^2/day

=1941.8 kWh/m^2/year

Step.2: Average daily load demand:-

Battery rating: 20Ah, 36 volts Energy required=20*36 =720 Wh

Step 3:-Total pv panels energy needed= 720*1.3

(1.3 =multiplied by load battery Wh/day)

= 936 Wh/day

Step 4:- Size of PV panels= total pv panel energy/4

(4 is solar generation factor)

= 936/4 =234 Wh /day

No. of PV panels = total energy of panel needed/wattage available(module)

= 234/110

=2(approx.)

Battery sizing (backup battery):-

Total energy use = 720 Wh

Nominal battery voltage = 36V

Days of autonomy = 1 day

Battery capacity = 720/(0.85*0.6*36)

= 40 Ah

Step 5:Solar charge controller sizing:-

Pm=110W

Max voltage(Vm)= 18 V dc

Max current(Im)= 12.22A

Voc = 21.6 V

Isc = 12.47A

Solar charge controller = 2*12.47*1.3 = 33A

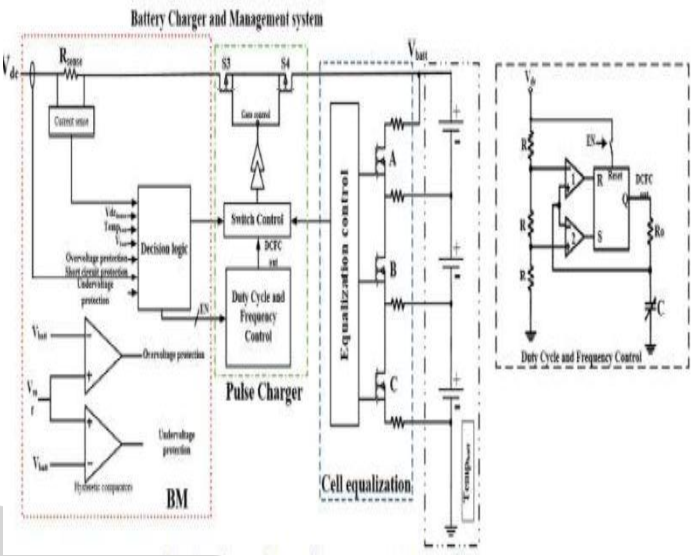

Fig.3. Implementation of solar panel & DC

V. CONCLUSION

The power sector is currently the greatest carbon emitter in India. Nonetheless, carbon emissions from the transport sector are increasing rapidly as well. The control of carbon emissions from these two sectors is related to the successful achievement of carbon emission control objectives. Thus, this study develops a model that combines solar power stations and EVs to simultaneously reduce pollutant emissions from the power generation and transportation sectors. The initial investment for this project is large and that charging facilities are not readily available in most cities, the EVTR commercial model is a suitable choice for the initial stage.

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