Unidirectional charging in electric vehicles using flexibility

Ranjith Raj K[1], Sri Anoop V P[2]
[1]*B tech Student, Electrical and Electronics Engineering, A P J Abdul Kalam Technological University, Kerala, India*
[2]*Assistant Professor, Electrical and Electronics Engineering, A P J Abdul Kalam Technological University, Kerala, India*

***Abstract*- Increase in electric vehicle mobility has increased the growth of vehicle to grid technology. Implementation of vehicle to grid technology requires dedicated vehicle battery charger .in this paper a new method is used. It can charge battery both in fast and slow mode .It allows peak load shaving, load leveling, voltage regulation and improvements of power system stability. The performance of the controller is verified by simulation under different operating modes such as fast charging, fast discharging, slow charging slow discharging. Here we use unidirectional charging techniques using flexibility without the addition of extra costs.**

1. INTRODUCTION

Bidirectional chargering is push of electricity to the battery or electricity can be taken from the car battery and push to the grid. To the plug in owners, bidirectional charging offers fewer benefits. The cost of the battery is high, battery exposes wear and tear and also it increases the complexity in designing of the meters.

In contrary, unidirectional chargers draw power from the utility grid. This is implemented by using v2g techniques so that the disadvantages of bidirectional charging such as cost, performance, safety, standards etc has been solved by using v2g in unidirectional charging.

The advantage of unidirectional charging is that , it can participate actively in the electricity market both as buyer and seller. Thus it increases or opens a platform for entry of newer companies to flourish in the market. Another advantage is that load curtailment is the another way of mechanism used in this market. In the future scenario, this load curtailment can be further extended.

2. TIME FLEXIBILITY IN EVS LOADS

A specified energy load with no flexibility in quantity is called energy load. For large quantities we use LSE system.ie Load serving entity. Such a system in which LSE is used is called as demand by regulators. The LSE meets the demands without any shortfall .If the charging is linked to this demand contracts, shortfall can be reduced .This can be divided into 2;

Short term opportunity charging: Short term opportunity charging where charging is done for shorter period of time. This allows charging of vehicles along highways major roads, coffee shops, restaurants etc. The advantage of this method of charging is that maximum transfer of load or charge can be done. Also the extra cost is linked with local pricing so that price is low.

Fast charging: In fast charging, the charging is done for a shorter period. But here the difference is that charging can be done only by means of electric charge filling stations located at several areas like our petrol pumps. Here we have to pay extra for the charging that we do. Usually during long trips we use this type of charging.

3. CHARGER CONTROLLED SCHEDULING OF POWER

The suitable objective of the charger controller is to minimize cost.ie it gives maximum efficiency for the battery with minimum cost. There are 2 forms used for controlling of chargers:

In the first method, it obtains or takes charge directly from the utility and gives it to required vehicle owners at lower costs. The advantage is that payment

is done in advance. The expected prices are predicted by using data.

In the second method, a cost function is formulated using charge optimization. Here the targeted energy is weighted along with cost. The advantage of this method is that demand shifting strategy does not affect ancillary services.

A) CHARGE OPERATION USING COST FUNCTION:

Here the power drawing methods are taken by grid connected vehicle such as one way pricing from utility. Here the vehicle connected to grid uses maximum charge when price of electricity is cheaper. With the introduction of EVs, the demand has become quite high at cheaper rate. The grid capacity is such a high, but still faces overloading issues. So to avoid that, a demand charge is introduced so that they can recharge as they desire.

The equation for energy cost is given by,

$$J = \min \sum_{k=h}^{H} C(P_k) \times (P_k \times \Delta t)$$

$$\text{such that} \sum_{k=h}^{H} P_k \times \Delta t = E_{des} \qquad (1)$$

$$0 \le P_k \le P_{max}$$

based on linear weightings

$$C(P_k) = C_k^0 + \alpha_k \times P_k \qquad (2)$$

and a retail rate

$$CC = C_k^0 + \theta(P_k - P_0), \quad \{\theta = 0 \ \forall P_k \le P_0\} \qquad (3)$$

J is the charging cost function;

A k is the weight on hourly power draw at time k with units of cost per kilowatt;

Ck0 is the base hourly price of electricity;

P k is the scheduled power draw at time k;

P0 is a utility-enforced charging rate threshold above which there is a demand charge;

Δ t is the length of charging sub-period in hours;

P max is the maximum charger power permitted (based on the outlet, a rating limit, or other predetermined limit);

h is a connection interval index;

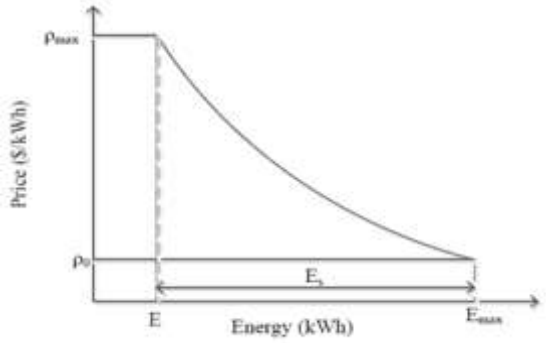
H is the user set time for charging completion;

E des is the desired total charger energy draw from the grid;

θ is the retail rate demand charge factor when P k>P0.

B) PRICE SENSITIVE ENERGY BIDDING

In this method the owner can bid for the energy in the day to day market. They can fix the desired price they feel. Here the owner is the king. There are set of rules to be followed in bidding. If the market clearing price is higher than the bid, then bid will be accepted or else it is rejected.



It is risky and requires intelligent tracking for doing bidding.

4. ANCILLIARY SERVICE GAIN

The energy usage for suitable plug in vehicles is 200 watt/hr. The vehicle chargers are self metered. The bandwidth is limited. The charger can adjust the amount of power. There are 2 types of regulation: Active power regulation: It is considered as a revenue source to a unidirectional charger. Reactive power regulation: It provides reactive supports even if the batteries are full.

5. CONCLUSION

Here v2G benefits using unidirectional charging is obtained. The cost saving using charging flexibility encourages entry of vehicle owners. The entry of LSEs has saved cost. It has also regulation in capacity.

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