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Role of Electric Vehicles (EVs) for reactive Power Compensation in V2G Systems: A Review

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Abstract: Recent advances in battery and electric power train technology have been expedited by aggressive marketing and significant government assistance. Battery manufacturing costs have reduced dramatically during the previous three years. By integrating these renewable energy sources with the grid, it becomes possible to power EV loads using clean energy. However, PV power generation is intermittent and dependent on factors like location and weather conditions, making it less stable. To compensate for this variability, a battery storage system is proposed to store excess energy and ensure a steady supply of power. This article contains a brief information about the solar energy, wind energy system, electrical vehicle, vehicle to grid charging and various optimization techniques related to Electric vehicles.

Keywords: Photovoltaic System, Wind Energy System, Vehicle to Grid, Electric Vehicle, Battery Energy Storage System.

I. INTRODUCTION

Renewable energy sources utilized in distribution networks, in conjunction with the electrification of charging stations in smart grids, offer a means of increasing power conversion efficiency and reducing emissions.

The Microgrid is made up of a collection of dispersed energy sources and storage devices that are used locally by a variety of load types and are function in either a grid-connected or islanding mode. Figure 1, illustrates a typical EV charging station as part of a Microgrid system. However, as the number of EV charging stations grows, so does the strain on the power grid. This is because more people are using electric cars. In this case, local renewable energy sources are used with the right power converter topologies to meet power consumption concerns.

EV Charging Framework and Standards

When you want to charge your car, you usually use micro-grid systems that are AC, DC, or hybrid. The charging station is powered by high voltage AC or DC. The charger then adjusts the voltage to charge the EV battery. You can choose from a lot of different types of EV charger power output ratings

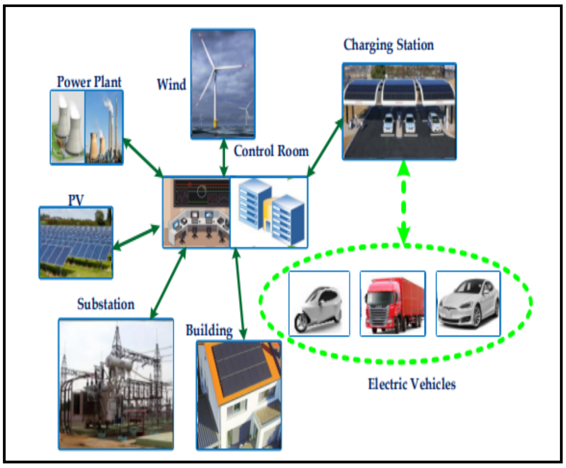

Figure 1. An EV-charging stations as part of the micrograds infrastructure

II. Related Research

There have been a lot of different ways to charge electric cars since the first ones were made. When it comes to charging, the circuit topologies, charging position, connection type (conductive, inductive/wireless, and mechanical), and waveform all play a role (dc or ac),. Most likely, there will be a lot of ways to make it easier for a PEV to get charged. Dedicated, on-board, conductive, ac, and unidirectional chargers are some of the most well-known chargers in the industry and literature that first piqued the interest of carmakers.

M. Shahriman et.al. (2018) - The Lagrange theorems are used in this paper to come up with a new way to make the state-space averaged model of dc-dc converters based on relative variables. Averaged mathematical models of boost, buck, and buck-boost converters have been used to look at steady-state processes in CCM and DCM (DCM). A new way to get averaged models lets you figure out not only the process's constant parts, but also its pulsation parts and the length of its steady-state time periods, which is a big advantage over traditional averaging methods. It was possible to figure out how much the voltage transfer coefficient of the converters and the voltage ripple of the storage choke changed with the amount of current that was being used.

GuangdiLi;Jinet.al. (2019) - This paper talks about how to make a non-isolated, high-gain dc-dc converter. Two boost converters and two voltage multiplier cells are all you need to make a converter. You don't need any other parts (VMC). People have made a lot of high-stepup DC–DC converters before. This one is different because it doesn't put as much strain on the semiconductors as the voltage gain increases. In ZVZCS (zero voltage and zero current switching) mode, all of them work. That's what the suggested converter does as well. During this state, there is no change in the flow of electricity. Turn off all of the circuit breakers in your house or office. Good news: Switching loss has also been cut down. This converter is better than other high gain dc-dc converters because of these things. You can see the steady-state analysis and design considerations for a typical 40 V/1100 V, 490 W, 25kHz converter below.

Oddhi Rakesh; et.al. (2021) in this study, we show off a new DC-DC converter that works both ways. The unique connection mechanism of the LVS device and three cascaded bidirectional boost converters make it possible to split the current into three separate streams. They are used on the side of the converter that has a lot of electricity (HVS). The steady-state voltage-current relationship of the proposed converter is looked at in this study, and the voltage-current relationship is found. Finally, a simulation model is used to show that the theoretical analysis is correct.

Hiroaki Matsumori et.al. (2021) This one shows how to make a GaN power source that can step down a DC-DC converter for cars. A hybrid electric car has a main battery of 200V and an extra battery of 13.6V. They work together to get the electricity from the main battery to the extra battery. There is a type of DC-DC converter called an LLC converter, and it is very efficient. There are two things that happen when there are big changes in the voltages at the input or output of an LLC resonant converter: This is why an LLC resonant converter has a DC to DC boost-up converter. This helps protect the converter's efficiency from changes in voltages. Add another circuit, like the boost-up chopper in this example, and the overall efficiency of the system goes down. It's not good to do that, so you should not do it. Use GaN power devices in the boost-up chopper to make sure it works as well as possible. As long as there is a lot of power being put out, the converter's efficiency is 99.03 percent, which doesn't change the overall efficiency of what it's doing. This means that it doesn't make the system less efficient. This means that it doesn't even need a DC to DC boost-up chopper in order to get 10 watts per cubic cm3.

III. Optimization Method

1. Physic or society inspired algorithms

Before, when dealing with DGA situations, different types of intelligence search methods have been combined as heuristic solutions. In order to solve the DGA problem, fuzzy set-based algorithms and traditional optimization techniques have both been used. A lot of people have been looking into meta-heuristic methods for DGA problem solving in the last few years.

2. Simulated annealing

An annealing method is used to show how to solve the optimization problem. Probability functions are used to reject or accept new solutions so that people don't get stuck in the best places in their area. This method was first called [14] the method includes things like initialization, perturbation, cooling schedules, acceptance probabilities, and so on. Cooling and heating are very important to getting great results with this method. [13].

3. Harmony search

In the year 2100, he came up with the basic Harmony Search method. [1] This is how the researchers came up with IMOHS, an expanded version of general harmony search that can be used for many different things. It was based on work done by Nekooei and Farsangi and their colleagues (NGHS). " IMOHS is a musical harmony algorithm," says the person.

4. Tabu search

The Tabu Search method was made in 1986 to help with planning and organizing optimization issues. How to deal with combinatorial problems can be done in a reasonable amount of time by using a method that doesn't need a lot of practise. It can also pass on the best ideas in your area. There are a lot of sub-processes that make up this optimization process. These are things like moving, the local area, the tabu list, longing, escalation, and variation. The goal of this technique is to look at a wide range of memories, including short-term and long-term memories.

5. Particle swarm optimization

Optimizing Particle Swarms In 1995, Kennedy and Eberchart came up with a way to find the best way to do something. It was based on the social behaviour of fish schools or bird flocks. General-purpose generators have now been made bigger and moved to new places for IEEE 33 or 70 bus test distribution methods.

6. Ant colony

Researchers first used the ant colony optimization (ACO), which is a community-based strategy that was first used in the late 1990s [16]. This method, which is an extension of ACO, has worked better in most engineering cases.

7. Artificial bee colony

DervisKaraboga came up with [8] the Artificial Bee Colony based on the idea that honeybee swarms are quick-witted. Colony size, iteration, and variable limits are all that is needed for ABC's basic form to work. The user has to choose or set these settings first. In the beginning, this method is used to solve numerical optimization problems. [16].

8. Genetic Algorithm

The natural election and the gestures that are passed down from generation to generation are the foundations of this search strategy. Because it doesn't put any limits on how different and convex a goal function can be, GA is better than other methods because it doesn't. Uses clarifications from one cohort to the next, which makes it less likely to come together. People convert and grade to get the findings, which are then randomly chosen. Thus, GA's search strategy would not be influenced by the early results, so it would not make changes to it. It was suggested by [8] that GA and an improved Hereford ranch approach (a variant of GA) for DG sizing should be used. It is possible to use GA to solve ODGP problems that have reliability constraints [6]. GA was used to solve an ODGP that had variable load models that looked at power, scattered loads, and sustainable power cumulative load [21].

IV. Future Scope

The quality of an electric car's batteries has a direct effect on how long it can go. According to these characteristics, we looked at a lot of different types of batteries. We also talked about the technologies that could be used in the future, like graphene, which is thought to be a good way to store more electricity and charge faster. The electric car could also benefit from this kind of technology, gaining more range. This could help drivers and users get used to the cars.

Batteries with more capacity will also lead to faster and more powerful charging modes, as well as higher wireless charging methods. It's also possible that making a universal electric car connector could be useful. When it comes to the future of Smart Cities, electric cars will play a big role, and having flexible charging options that can be customised to meet the needs of each person is very important to their success. Batteries and Smart City standards are going to change the way things work in the future, so the BMS should think about that.

Very High-Power Charging. The condition of an electric car's batteries has a direct effect on how far it can go. We looked at a lot of different types of batteries based on these features. Many new technologies, such as graphene, were also talked about. It's expected to be a great way to store more electricity and charge it faster. Also, the electric car could benefit from this kind of technology because it could have more range. This could help both drivers and people who use cars get used to them.

It will also be easier to charge faster and more powerfully, and use wireless charging that is higher. Creating a universal electric car hookup could also be good. To make Smart Cities work in the future, electric cars will play a big role, and having charging options that can be customised for each person is very important. Batteries and Smart City standards will change how things work in the future, and the BMS should think about this.

Wireless Charging. The technology has been used in a number of countries, but it hasn't yet been made available to the public in the United States, and its market potential isn't clear.

Vehicle-to-Grid. Electric vehicle batteries may one day be able to provide power to the grid, thanks to new technologies.

Vehicle-to-Home. Next-generation technologies may allow cars to be used as backup generators for homes and businesses that need electricity.

EVs are one of the best technologies for green and environmentally friendly transportation systems. The more electric cars are used, the more positive things will happen, like less reliance on fossil fuels, a big cut in toxic pollution, and the ability to help with the integration of renewable energy into existing electric grids. This chapter looked at the most recent research on how electric vehicles (EVs) work with renewable energy sources (RESs) like wind energy, solar photovoltaics, and EV coordination to make transportation more environmentally friendly. Some of the main issues and possible solutions were also talked about in great detail. The government, power companies, EV and aggregator manufacturers, policymakers, and owners all need to help make the pairing of EV and RES technology work. It is hoped that this study will help everyone who is involved in this field better understand the challenges and issues and help them to do more in this field.

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