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A Review on Photovoltaic based DC Fast charging station for Electric Vehicles

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The adoption of Electric vehicles is continuously rising due to the spike in oil prices and environmental pollution. The Major impediments to the adoption of an electric vehicle are charging time, range, and charging infrastructure. DC Fast charging station provides quick charging to electric vehicles and becomes one of the attractive solutions for overcoming the impediment to adopting electric vehicles. In this paper, PV interconnected DC fast charging stations with specific attention to the standards of charging, charging components, operating modes, Energy management system, and Battery management system are discussed.

Keywords: Photovoltaic (PV) Charging, AC Grid, Energy Management System (EMS), Electric Vehicle (EV), Renewable Energy Source (RES), Battery Management System (BMS), Maximum Power Point Tracking Technique (MPPT)

1. Introduction

Electric vehicles do not emit greenhouse gases, ultimately, they can contribute clean environment [1-3]. Electric vehicles have an advantage over conventional internal combustion engine vehicles for their superior performance, reduced fossil fuel consumption, and enhanced battery technology [4]. The Major impediments to the adoption of electric vehicles are due to more expensive, range concerns, and more charging time. Charging time can be significantly reduced using the DC fast charging stations. The DC Fast charging stations posed a large and unpredictable load to the grid. Recently, the growth of renewable energy leads to becoming a source of secondary charging for electric vehicles. Among all RES, solar is a more popular Renewable energy resource for day-time charging. With the continuous declined cost of solar modules, PV becomes one of the attractive solutions for the charging source of electric vehicles. The PV systems are almost maintenance-free and easy to set up. In [4], the authors incorporate the various architectures of PV-grid systems that are suitable for AC and DC buses. Nagizadeh and Y. Du [5, 6] presented an analysis of suitable topologies for the connected PV charger. It is to discuss the major attention on bidirectional dc to ac and DC to DC converters along with MPPT algorithms. The review of literature addresses various issues related to the grid interconnection of PV systems for EV charging. In this paper, the PV charging station is classified into two types based on architecture They are i) PV charging systems in the grid and ii) Standalone PV charging systems: This document focuses on the standards of charging, charging components, operating modes, Energy management system, and Battery management system.

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2. TYPES OF EV CHARGING INFRASTRUCTURE.

An electric vehicle charging infrastructure (EVCI) is a platform that powers electric vehicle batteries for charging, using intelligent communication and protection techniques to ensure safe current flow. Electric vehicle charging infrastructure is also known as EV supply equipment (EVSE) and EV charging point (EVRP). The infrastructure of EV charging is broadly classified based on its ownership and use. They are classified into private, semi-public, and public.[7]

2.1 Private charging: This type of charging is dedicated to a personal EV or EV fleet owned by one entity. They are located in independent homes, and dedicated parking spots in offices. It is owned by individual owners of EVs, fleet owners, or operators.

2.2 Semi-public charging: This type of charging is shared for the restricted users of EVs. These charging points are at apartment complexes, health canters, shopping complexes, varsities, and municipal canter buildings. Host properties, original apparatus makers, and charging point operators are the owners of the Semi-public charging point.

2.3 Public charging: This type of charging is open to all EV users. They are available at public parking lots, street parking, charging plazas, petrol pumps, and high ways and metro stations. They are owned by municipal authorities, PSU, and charging point operators

3. CHARGING STANDARDS

The large adoption of electric vehicles depends upon the safe, reliable, and accessible EV charging infrastructure. The charging infrastructure is chosen between optimization of charging infrastructure and the time of charging. These are mainly two types of EV charging 1) AC type and 2) DC type. In the case of AC charging AC is supplied to onboard electric chargers that are converted into DC and supplied to EV batteries. Again, AC charging is classified into two types i) Stage 1 AC Charging and ii) Stage 2 AC Charging.

In the charging of level 1, the supply voltage is 120V AC with a power rating ranging from1.3 kW to 2.4 kW and level 2 charging has a supply voltage of 240V with a power rating ranging from 3kW to 19 kW. In the case of DC charging, AC is converted into DC at a charging point that is directly supplied to the EV battery. It is also known as level 3 charging. It possessed a supply voltage of 480 V with a power rating ranging from 50 kW to 350 kW. The charging time of an electric vehicle depends upon the following factors i) Battery ii) Nominal power of the charger iii) No. of electric vehicles that are connected to the charger at a given moment. EV charging standards are different for different parts of the world. But there are three generally accepted standards for electric vehicle supply equipment which include chargers charging standards are classified as follows

Table 1: Charging standards

Type	Voltage rating	Current rating	Power	Time
Level-I	120V	12-16 amps	1.3kW to 2.4 kW	6-10 Hrs
Level-II	204-240V	30-50 amps	3kW to 19kW	1-3 Hrs
Level-III	480V	100 amps	50 Kw to 350 kW	30 Mins

Different types of connectors of the EV chargers are shown in the figure among those DC fast chargers are high-powered chargers available in the market. The DC fast chargers can produce a full charge of slightly more than 30 minutes. The DC fast chargers have multiple standards for connections. The DC fast chargers have three types of connections, CHAdeMO, CCS, and Tesla.

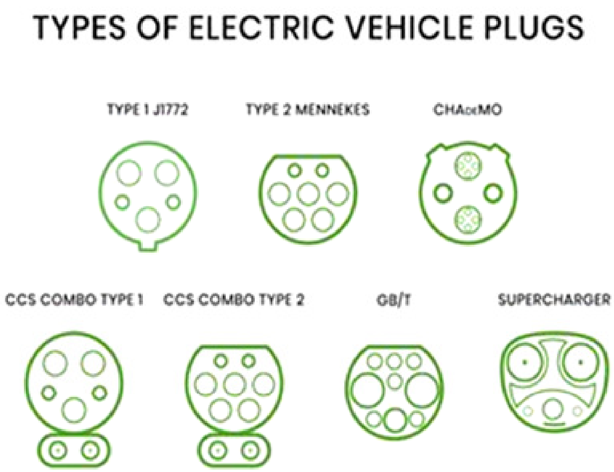

Fig 1. Types of EV charging connectors

3. PRINCIPLE OF DC FAST CHARGING

DC fast charging, as the name suggests, supplies direct current directly to the electric vehicle battery. AC-DC conversion takes place at the charging station before the electrons enter the vehicle. Therefore, DC fast charging can provide much faster charging than level 1 or level 2 charging. DC fast charging bypasses all the limitations of the onboard charger and conversion required. This greatly increases the charging speed. Charging time will vary depending on factors such as battery size and dispenser output, but most vehicles can be charged to 80% in about an hour using most DC fast chargers available today.

DC fast charging is essential for high mileage, long trips and large fleets. Fast turnaround time allows drivers to recharge during the day or during short breaks, without having to stay plugged in overnight or for hours to get a full charge.

4. GRID INTEGRATED RENEWABLE ENERGY-BASED CHARGING SYSTEM.

The rapid increase of electric vehicles, there will cause huge electricity demand. Ultimately grid will be burdened. To mitigate this problem, renewable energy sources such as solar photovoltaic, wind, and biomass are being considered for this purpose. Wind energy systems are usually located in suitable locations where the wind is available. For an urban area, wind energy is not properly available therefore they are unattractive for use in EV charging. Biomass can be conveniently used as a source of EV charging. But it can pollute the environment.

To integrate with the existing grid, the solar PV system provides flexibility. There are abundant advantages of having the charging stations PV-powered. During day time, load demand is high, and due to that cost of electricity tariff is high. The substantial savings in cost will be achieved when charging is done through solar PV. Due to the above benefits, the solar PV system is more beneficial than any other renewable source of energy

5. SOLAR PV DC FAST CHARGING STATIONS

The charging system based on solar EVs is divided into two types. i)Grid-connected solar PV charging systems ii) Stand-alone solar PV charging systems [8]

5.1 Grid-connected solar PV charging systems

In this type of charging station, solar PV energy is used for self-consumption where the grid is used as a backup. The Major components present in this PV system are array, battery, and grid. In this PV system, it is used to charge the EV battery. If there is excess PV power, it will be used to charge the battery and also feed the grid. The price of a grid-connected system is less than a standalone solar PV charging system.

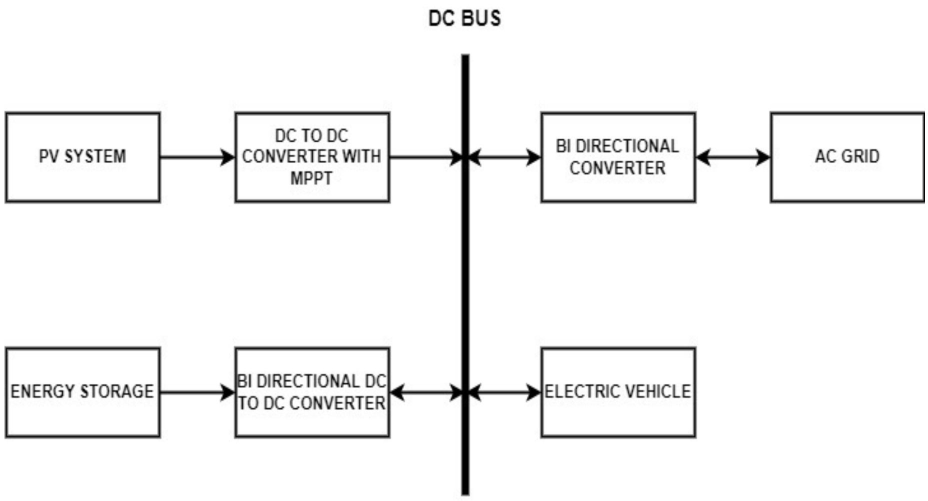

Fig (2) Grid-connected PV charging system.

5.2 Standalone solar PV charging system

In this type of charging station, the solar energy station is not connected to the utility grid. The energy generated by the solar PV array is stored in a battery system, which is also known as an EV stand-alone charger Battery storage system provides the power needs for charging

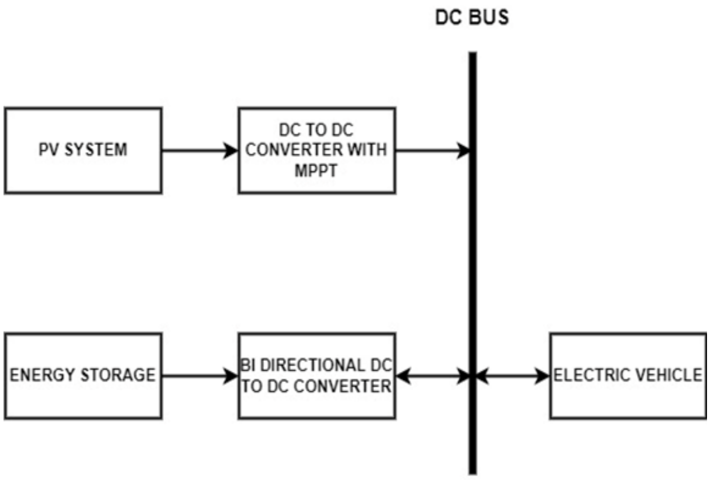

Fig 3. Standalone PV Charging station.

6. COMPONENTS OF SOLAR EV CHARGING STATION

The schematic diagram of a solar charging station for electric vehicles is shown in the below

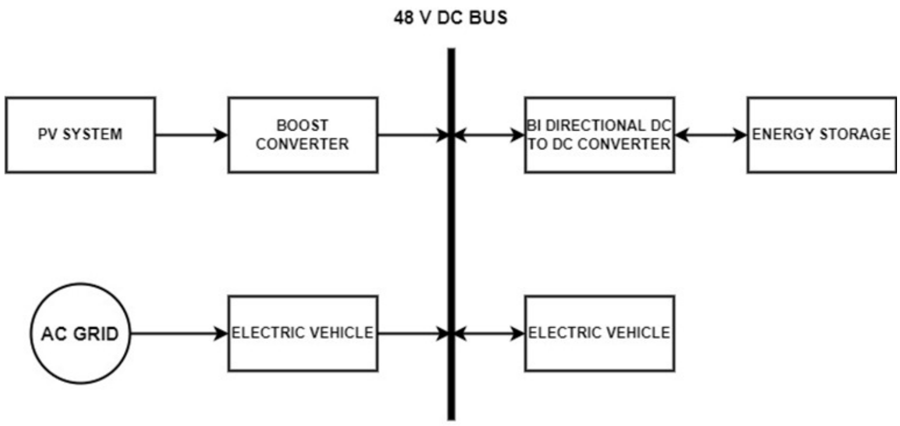

Fig (4) Components of PV charging station

6.1 PV Array:

A PV array is a linked collection of photovoltaic solar modules. Each photovoltaic module is composed of multiple interconnected. These cells convert light energy into electrical energy.

6.2 DC-DC Converters with the MPPT:

Using the traditional buck, boost, buck-boost specified as DC-DC converters used together with an MPPT controller in both stand-alone and grid-connected PV charging stations MPPT controller obtains maximum power from the PV array by adjusting the duty cycle of the DC-DC converter. There are several MPPT techniques available such as perturb and observe technique, hill climbing technique, and incremental conductance technique which are used with constant or variable steps. Evolutionary methods such as particle swarm optimization technique, fuzzy logic controller technique, and ANN techniques are used for manipulation of the partial shading and conditions of mismatch module. The comparison of various dc to dc converters is as given below

Table 2: Comparison of dc-to-dc converters

Feature	Buck converter	Boost converter	Buck-Boost converter	Cuk converter
Input current	Pulsed	Continuous	Pulsed	continuous
Output current	continuous	Pulsed	Pulsed	continuous
Output voltage magnitude compared with input voltage	Lesser	Higher	Lesser or Higher	Lesser or Higher
Output voltage	Same	Same	Reverse	Reverse

6.3 Bidirectional converters:

These types of inverters are used in grid-connected EV battery charging systems, which are shown in above Fig. (5). It is worked in both inversion and rectification mode. In rectifier mode, power is supplied from the mains to the DC bus. In inverse mode, power is supplied from the DC bus to the mains. Different topologies are implemented in the literature such as half-bridge inverter, full-bridge inverter, etc. [9]

6.4 Energy storage system:

One of the energy storage options for micro-grid is Battery Energy Storage System (BESS). Lithium-ion, Magnesium ions are some of the varieties of batteries used to store energy. The energy storage system takes energy and is stored for later use. The energy storage system provides solutions for various operational problems such as power quality, dynamic stability, reliability, and controllability, especially in the presence of intermittent renewable energy storage systems, mitigates load uncertainties, and improves microgrid stability.[10]

Table 3: Comparison of storage devices

Type	Power rating	Discharge time	Deployment time	Efficiency
Pumped Hydro	100-4000 MW	1hr-24hr	30 years	70-85%
Flywheel	<750kW	milli second to 40 min	20 years	90-95%
Compressed air	50-300 MW	1hour-24hours	30 years	70%-80%
Battery	<50MW	Second-hours	5-10 years	80% -90%
Hydrogen	<250kW	1hr-24hr	10-20 years	20-50%
Supercapacitor	<100kW	milli second to min	10000 cycles	90-95%
SMES	10kW-10MW	milli second to second	30 years	80-90%

6.5 Batteries in Electric Vehicles:

There is extensive research into the development of batteries for electric cars. Before, lead-acid batteries were exclusively used, but lead acid batteries have a problem of low specific energy and short cycle life later lead acid batteries are substituted by nickel batteries which have reliability and high density, but nickel batteries have self-discharge and heat generation problems at high temperature. Lithium-ion batteries are chosen in electric vehicles as their high-power density; high weight and size, therefore, the problems of low definite energy, poor temperature features, and chemical leakage are overcome with these batteries. The comparison of various batteries based on different specifications is as shown below:

Table 4: Comparison of batteries

Features	Lead acid	NiMH	Li-ion (cobalt)	Li-ion (Manganese)	Li-ion (Phosphate)
Specific Energy(wh/kg)	30-50	60-120	150-250	100-150	90-120
Internal resistance (Ω)	Very low	Low	Moderate	Low	Very low
Cycle life	200-300	300-500	500-1000	500-1000	1000-2000
Charge time(hours(h))	8-16 h	2-4h	2-4h	1-2h	1-2h
Self-discharge (Nominal)	5%	30%	<5%	<5%	<5%
Cell voltage	2V	1.2V	3.6V	3.7V	3.2V-3.3V
Cost	Low	Moderate	High	High	High

7. CHARGING MODES OF PV GRID SYSTEM

When the EV is plugged in, its soc is less than 100% and the central controller controls the charging process based on the EV battery status, PV power availability, and grid electricity price. In a general charger, it works in one of these five modes. [11]

7.1 Mode-1: Charging with PV only

In this operating mode, the battery is charged from a DC-DC converter using the MPPT technique and a DC charger. In this operating mode, the network is not connected. The DC charger regulates the voltage suitable for the profile of the EV battery charging

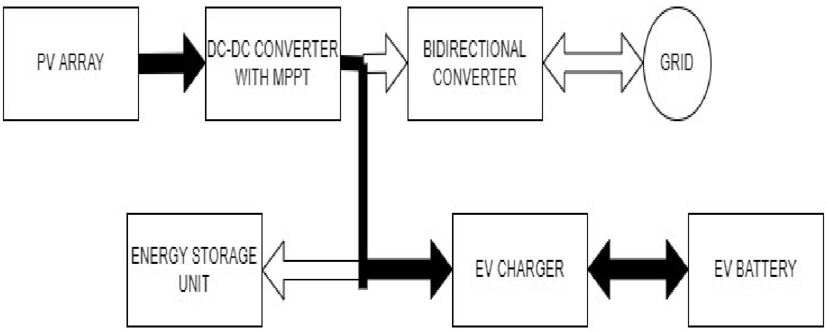

Fig. (5) charging by PV only.

7.2 Mode-2 (charging with grid only)

If the PV is unable to supply power, the EV battery is charged from the grid. The bidirectional converter works in rectification mode. The DC charger regulates the voltage suitable for the EV battery charging process

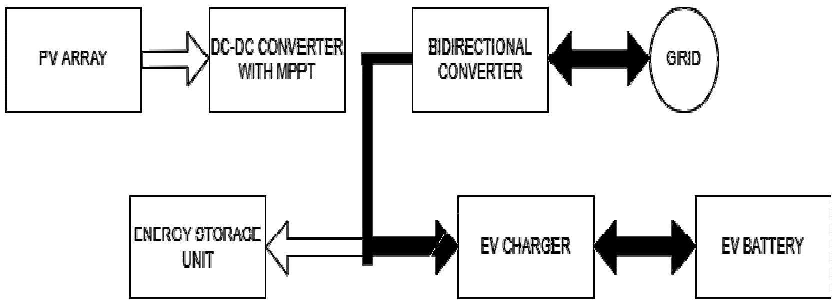

Fig (6) charging by grid only

7.3 Mode-3 (Charging with PV and grid)

In case the PV may only be able to supply a certain amount of energy, the grid can be used to supply an insufficient amount of energy. The amount of energy that has been supplied by the grid depends on how much energy the PV system has supplied. PV performance is continuously monitored by a central controller and adjusts grid performance accordingly for dynamic irradiance levels.

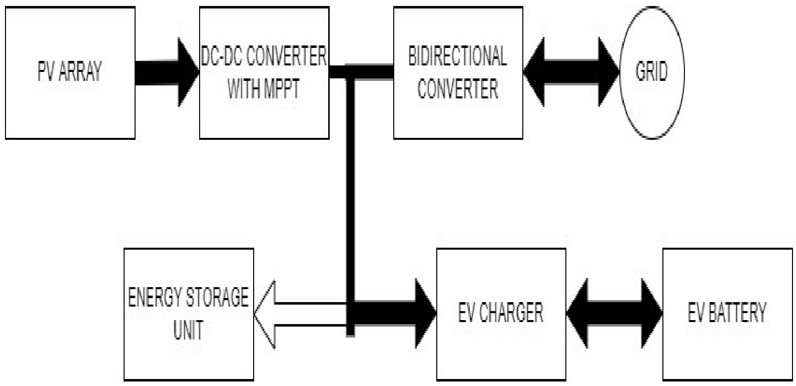

Fig. (7) Charging by PV and grid.

7.4 Mode-4 (No EV Charging)

When the EV is not available, power is generated from PV directly supplied to the grid. This can be achieved through the two-stage conversion process. i.e., DC-DC converter with the MPPT technique and bidirectional converter that works in inversion mode

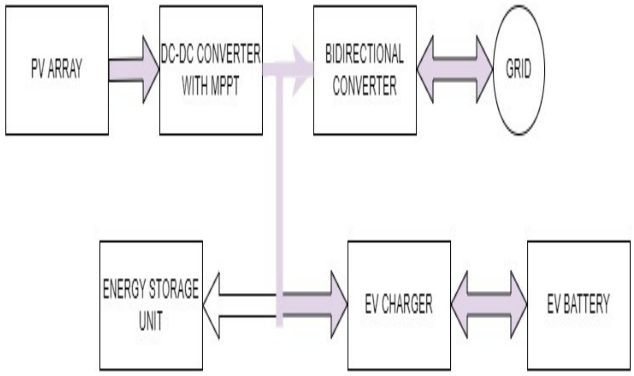

Fig (8) Without EV charging

7.5 Mode-5 (Vehicle to Grid)

In this method of operation, the power is transferred from the vehicle to the grid. In particular hours of the day, peak demand is high, so tariffs will be more. At that time, if the EV transfers power to the grid, it will be more benefit able to the owners of the EV. However, transferring power from the EV battery to the grid reduces the lifetime of the battery

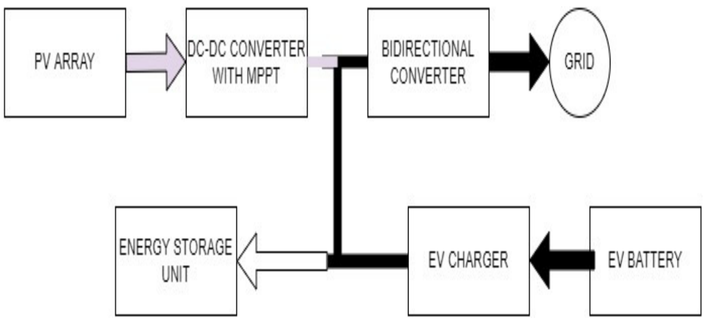

Fig. (9) Vehicle to the grid.

8. ENERGY MANAGEMENT SYSTEM (EMS)

The most critical issue with a solar PV system is due to its intermittent nature throughout the day. One of the solutions to this problem is to integrate with the battery [12]. An Energy management system exchanges energy between different devices using a control strategy. EMS design is difficult as its the sporadic nature of renewable sources of energy. Recent studies have been conducted on EV fast charging stations with battery storage systems with PV generators. The goal of energy management is to monitor and optimize the consumption of energy and reduce emissions of greenhouse gas. The energy management system contributes to fleet electrification success and helps to minimize the costs of EV charging. The following are the objectives of the Energy management system.

8.1. Management of peak load and demand charges.

The cost of power increases with demand, it also depends upon location, seasonal, time of day, and event- based. An energy management system increases the ability to control the consumption of power and it also minimizes the impact of demand charges and results in cost savings

8.2 Supports long-term sustainability goals.

The energy management system analyses the current power consumption and sets meaningful goals. It reduces carbon emissions by utilizing renewable sources of energy. These systems are positioned to manage emissions associated with widespread electrification.

8.3 Integration of solar with an energy storage system.

The methods of energy management systems rely less on a grid and depend more on locally generated renewable resources of energy. It is impractical to depend totally on solar PV generation because of its intermittency. so the storage system is also integrated along with the solar PV system. Usage of energy management system exchanges energy among sources. Based on the algorithm, it can optimize the overall cost of charging.

8.4 Realization of energy trends and forecasting consumption of energy.

Energy management can create high accuracy in data to make more accurate forecasting that leads to more competitive rates. It allows energy managers to shut down non-essential processes, and run certain operations during non-peak hours of the day.

8.5 Promote no resilient and avoid operational disruptions.

Energy management helps to reduce energy consumption and supports the overall performance of the grid. It helps to draw less power during high demand so that grid maintains the adequate capacity to avoid block outs and service interruptions. Energy management systems that incorporate a battery storage system can keep EV charging running under power outages

9. BATTERY MANAGEMENT SYSTEM (BMS)

The performance of any electric vehicle depends on several factors such as cell voltage, battery life, and health. The battery management system's role in all-electric vehicles is to ensure full monitoring of the battery tasks [13]. The real-time information is obtained with the help of batteries to improve the life of the battery and safe operation. The continuous improvement of Li-ion batteries leads to a high density of power, self-discharge is lowered and the cost is also reduced. Battery management is a special electronic circuit that ensures the safety and stability of these battery packs. A battery pack is comprised of multiple module cells and each module is a set of cells. The battery management system monitors up to cell level to ensure the safe operation of the battery pack. Battery management is shown in following figure (10)

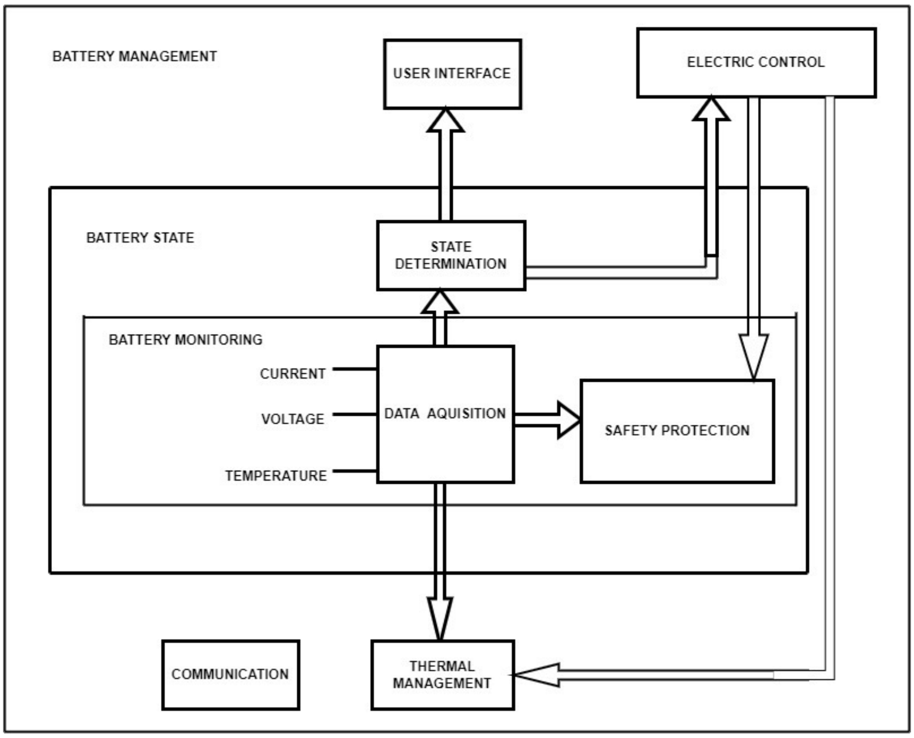

Fig. (10) Battery management system

A battery management system has been classified based on the circuit design, its topology, and the voltage range. [14]

9.1 Based on design.

Based on the design, it can be further classified into two types

9.1.1 Protection circuit model:

A protection circuit model is an electronic circuit that protects each cell in a lithium-ion battery from extremes in voltage, current, and temperature. It maintains the operation of each cell in a safe and enhances the life of the battery.

9.1.2 Battery management system.

It is an intelligent electronic protection circuit, It carries extra modules like manage circuitry, control, and display modules.

9.2. Based on topology.

It can be classified into two types

9.2.1 Centralized BMS

A single board contains central control and intelligent circuitry for all operations and internal communications. Centralized controller monitors and maintains cell voltage and temperature.

9.2.2 Decentralized BMS.

Cell monitoring and smart circuit boards are components of various assemblies of decentralized BMS. This topology is highly reliable when compared to centralized BMS.

9.3. Based on voltage.

It can be classified into two categories

9.3.1 Low voltage (LV) BMS.

Includes low voltage class 1 below 60V. It covers all-electric vehicles including two and three-wheelers.

9.3.2 High voltage (HV) BMS.

The HV battery management system consists of a high voltage class 2 equivalent to 900V DC and a high voltage class 3 equivalent to 1500V or less. Its application includes automotive and energy storage systems

10. BATTERY MANAGEMENT SYSTEM FUNCTIONS

The battery management system performs the following functions to ensure safe and reliable battery operation. They are shown in fig (10)

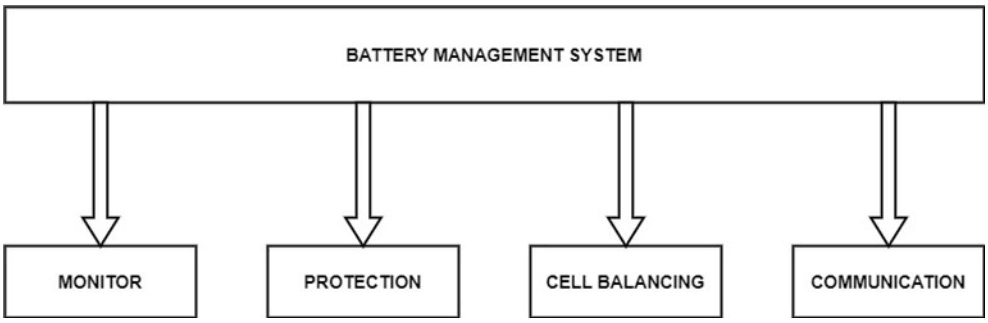

Fig. (11) BMS Functions.

10.1 Monitoring function:

The battery management system uses sensors to monitor the voltage, current, and temperature of each cell. These readings are used to assess the state of charge (SOC), health status (SOH), energy calculations, and current thresholds. The continuous monitoring of these parameters helps to maintain the safety of the battery pack and improve the span of life.

10.2 Functioning in protection:

The battery management system guarantees the safety of the battery pack against external environmental influences such as overheating and heat management of the battery pack. These conditions can cause the battery to fail. To avoid these situations, BMS makes sure that is in operating in a safe zone.

10.3. Balancing Cell:

Balancing cells are one of the most important activities performed within a battery pack to extend battery life by reducing the number of charges and discharge cycles this is a kind of optimization in which BMS balances the charge and discharge of each cell in the module. Fluctuations during charging and discharging of each cell result in a significant energy imbalance between cells, but discharging limits the capacity of the battery pack during charging. Cell balancing is divided into two types.

10.3.1 Passive balancing:

Passive balancing is a common technique for stabilizing energy between cells in a module. Excess energy is separated by providing a single drain for the cell. Additional coolant is needed to remove excess energy, which is dissipated as energy.

10.3.2 Active balancing:

Active balancing is a complex and efficient process for balancing the energy of cells. Energy redistribution takes place between cells by dissipating excess energy with the help of devices of power by removing from the strong to the weak cells.

10.4. Communication:

The entire major functions of the Battery Management System (BMS) are; monitoring, protection, and cell balancing which communicated with each other. Therefore, different communication protocols are used due to that reason.

11.Conclusion

The current research paper covers the different aspects of PV DC fast charging stations for electric vehicles. It discusses the various charging standards, types of solar PV charging stations, and components of a solar PV charging station. Various modes of operation of charging stations have also been discussed. The energy management system monitors and optimizes the power transfer among the various components of the charging station. Its objectives are also covered in this paper. Classification of the battery management system and its various function also discussed in detail.

References

[1] *Ratil H. Ashique, Zainal Salam, Mohd Junaidi Bin Abdul Aziz, Abdul Rauf Bhatti, Integrated photovoltaic-grid dc fast charging system for electric vehicle: A review of the architecture and control, Renewable and Sustainable Energy Reviews, Volume 69,2017, Pages 1243-1257, ISSN 1364-0321https://doi.org/10.1016/j.rser.2016.11.245.*

[2] *N. Sujatha, S. Krithiga, RES based EV battery charging system: A review, Renewable and Sustainable Energy Reviews, Volume 75, 2017, Pages 978-988, ISSN 1364-0321*

[3] *L. Tan, B. Wu, S. Rivera and V. Yaramasu, "Comprehensive DC Power Balance Management in High-Power Three-Level DC–DC Converter for Electric Vehicle Fast Charging," in IEEE Transactions on Power Electronics, vol. 31, no. 1, pp. 89-100, Jan. 2016, doi: 10.1109/TPEL.2015.2397453.*

[4] *Chandra Mouli G., Bauer P., Zeman M. Comparison of system architecture and converter topology for a solar powered electric vehicle charging station. In: Proceedings of the 9th International Conference on Power Electronics and ECCE Asia (ICPE-ECCE Asia): IEEE; 2015. p. 1908–15.*

[5] *Naghizadeh N., Williamson S.S. A comprehensive review of power electronic converter topologies to integrate photovoltaics (PV), AC grid, and electric vehicles. In: Proceedings of the transportation electrification conference and expo (ITEC), 013 IEEE; 2013. p. 1–6.*

[6] *Du Y, Zhou X, Bai S, Lukic S, Huang A Review of non-isolated bi-directional DCDC converters for plug-in hybrid electric vehicle charge station application at municipal parking decks. In: Proceedings of the applied power electronics conference and exposition (APEC), 2010 twenty-fifth annual IEEE: IEEE; 2010. p. 1145–51.*

[7] *V. M. Iyer, S. Gulur, G. Gohil and S. Bhattacharya, "An Approach Towards Extreme Fast Charging Station Power Delivery for Electric Vehicles with Partial Power Processing," in IEEE Transactions on Industrial Electronics, vol. 67, no. 10, pp. 8076-8087, Oct. 2020, doi: 10.1109/TIE.2019.2945264.*

[8] *M. A. H. Rafi and J. Bauman, "A Comprehensive Review of DC Fast-Charging Stations With Energy Storage: Architectures, Power Converters, and Analysis," in IEEE Transactions on Transportation Electrification, vol. 7, no. 2, pp. 345-368, June 2021, doi: 10.1109/TTE.2020.3015743.*

[9] *Jang, Y.; Sun, Z.; Ji, S.; Lee, C.; Jeong, D.; Choung, S.; Bae, S. Grid-Connected Inverter for a PV-Powered Electric Vehicle Charging Station to Enhance the Stability of a Microgrid. Sustainability 2021, 13, 14022. https://doi.org/10.3390/su132414022*

[10] *https://www.etransenergy.com/ThoughtmLeadership/Energy-management-for-electric-vehicle-fleets*

[11] *https://circuitdigest.com/article/battery-management-system-bms-for-electric-vehicles*

[12] *Wei Liu, Tobias Placke, K.T. Chau,Overview of batteries and battery management for electric vehicles,Energy Reports,Volume 8,2022,Pages 4058-4084,ISSN2352-4847,https://doi.org/10.1016/j.egyr.2022.03.016.*

[13] *Hoarau, Quentin, and Yannick Perez. "Interactions between electric mobility and photovoltaic generation: A review." Renewable and Sustainable Energy Reviews 94 (2018): 510-522.*

[14] *Mahmoud Shepero, Joakim Munkhammar, Joakim Widén, Justin D.K. Bishop, Tobias Boström, Modeling of photovoltaic power generation and electric vehicles charging on city-scale: A review, Renewable and Sustainable Energy Reviews, Volume 89,2018, Pages 61-71,ISSN1364-0321, https://doi.org/10.1016/j.rser.2018.02.034*

[15] *H. Tu, H. Feng, S. Srdic, and S. Lukic, "Extreme fast charging of electric vehicles: A technology overview," IEEE Trans. Transport. Electrific., vol. 5, no. 4, pp. 861–878, Dec. 2019*

[16] *R. Abousleiman and R. Scholer, "Smart charging: System design and implementation for interaction between plug-in electric vehicles and the power grid," IEEE Trans. Transport. Electrific., vol. 1, no. 1, pp. 18–25, Jun. 2015*

[17] *M.Gjelaj, S.Hashemi, C.Traeholt, and P.B. Andersen, "Grid integration of DC fast-charging stations for EV by using modular Li-ion batteries," IET Gener., Transmiss. Distrib., vol. 12, no. 20, pp. 4368–4376Nov. 2018.*

[18] *E. Veldman and R. A. Verzijlbergh, "Distribution grid impacts of smart electric vehicle charging from different perspectives," IEEE Trans.Smart Grid, vol. 6, no. 1, pp. 333–342, Jan. 2015.*

[19] *O. Beaude, S. Lasaulce, M. Hennebel, and I. Mohand-Kaci, "Reducing the impact of EV charging operations on the distribution network," IEEE Trans. Smart Grid, vol. 7, no. 6, pp. 2666–2679, Nov. 2016.*

[20] *A. Meintz et al., "Enabling fast charging—Vehicle considerations," J. Power Sources, vol. 367, pp. 216–227, Nov. 2017.*

[21] *C.Capasso and O.Veneri, "Experimental study of a DC charging station for full electric and plug in hybrid vehicles," Appl. Energy, vol. 152, pp. 131–142, Aug. 2015.*

[22] *Electric Vehicle Conductive Charging System—Part 1: General Requirements, Standard IEC 61851-1:2017, Feb. 2017, pp. 1–287*

[23] *Electric Vehicle Conductive Charging System—Part 23: DC Electric Vehicle Charging Station, Standard IEC 61851-23:2014, Mar. 2014, pp. 1–159.*

[24] *S.Manzetti and F. Mariasiu, "Electric vehicle battery technologies: From present state to future systems," Renew. Sustain. Energy Rev., vol. 51, pp. 1004–1012, Nov. 2015.*

[25] *SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler, Standard SAE J1772, Oct. 2017, p. 1.*

[26] *A.Burnham et al., "Enabling fast charging–infrastructure and economic considerations," J. Power Sources, vol. 367, pp. 237–249, Nov. 2017.*

[27] *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.*

[28] *X. Dong, Y. Mu, H. Jia, J. Wu, and X. Yu, "Planning of fast EV charging stations on a round freeway," IEEE Trans. Sustain. Energy, vol. 7, no. 4, pp. 1452–1461, Oct. 2016..*

[29] *D. Srinivas, K. Ramesh and V. Ganesh, "Optimal Design and Energy Management for Hybrid Wind-Solar PV based Renewable Energy System with Battery Storage: A Review," 2019 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), 2019, pp.155160,doi:10.1109/ICCPEIC45300.2019.9082356.*

[30] *Q. Dang, D. Wu and B. Boulet, "EV Fleet as Virtual Battery Resource for Community Microgrid Energy Storage Planning," in IEEE Canadian Journal of Electrical and Computer Engineering, vol. 44, no. 4, pp.431-442,Fall,2021,doi: 10.1109/ICJECE.2021.3093520*

[31] *M. Ahmadi, H. J. Kaleybar, M. Brenna, F. Castelli-Dezza and M. S. Carmeli, "Implementation of DC Micro Grid Tied PV-Storage Based EV Fast Charging Station," 2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 2021, pp. 1-6, doi: 10.1109/EEEIC/ICPSEurope51590.2021.9584631.*

[32] *Q. Cheng, L. Chen, Q. Sun, R. Wang, D. Ma and D. Qin, "A smart charging algorithm based on a fast-charging station without energy storage system," in CSEE Journal of Power and Energy Systems, vol. no. 4, pp. 850-861, July 2021, doi: 10.17775/CSEEJPES.2020.00350*

[33] *S. S. Varghese, G. Joos and S. Q. Ali, "Load Management Strategy for DC Fast Charging Stations," 2021 IEEE Energy Conversion Congress and Exposition (ECCE), 2021, pp. 1620-1626, doi: 10.1109/ECCE47101.2021.9595829.*

[34] *W. Vermeer, G. R. Chandra Mouli and P. Bauer, "A Multi-Objective Design Approach for PV-Battery Assisted Fast Charging Stations Based on Real Data," 2022 IEEE Transportation Electrification Conference & Expo (ITEC), 2022, pp. 114-118, doi: 10.1109/ITEC53557.2022.9814016.*

[35] *P. García-Triviño, L. M. Fernández-Ramírez, J. P. Torreglosa and F. Jurado, "Control of electric vehicles fast charging station supplied by PV/energy storage system/grid," 2016 IEEE International Energy Conference (ENERGYCON), 2016, pp. 1-6, doi: 10.1109/ENERGYCON.2016.7514120.*

[36] *P. S. Indu and M. V. Jayan, "Frequency regulation of an isolated hybrid power system with Superconducting Magnetic Energy Storage," 2015 International Conference on Power, Instrumentation, Control and Computing (PICC), 2015, pp. 1-6, doi: 10.1109/PICC.2015.7455752*