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Integrated renewable energy and smart grid system to improve voltage quality and harmonic distortion losses at electric vehicle charging stations

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ABSTRACT

Increasing the use of Electric-Vehicles (EV) is regarded as a step in the right direction to reduce air-pollution and carbon emissions. However, a dramatic increase of EV and charging stations has raised voltage quality and harmonic distortion issues that affect the performance of integrated renewable power sources (wind and solar) and smart-grid electrical transmission networks. This paper models an integrated electric-vehicle charging and battery storage system operating in the presence of unpredictable solar power sources. The aim is to enable the design of an electrical control system that develops the correct duty cycle to stabilize and regulate the voltage at the DC/DC power conversion station.

INTRODUCTION

Integration of large scale wind and solar farms into the UK transmission system has raised power quality, system stability and network synchronization problems. Between 2015-2016, wind and solar farms increased by 51.2% with total capacity of 8.1 TWh. In 2016, these renewable energy plants were connected to the UK national transmission system where they created several challenges of voltage quality and harmonic distortions due to variable wind flow/sunlight and variations in the electric load. This paper investigates an isolated micro grid to solve the problems of power flow due to the creation of transients, inrush currents and disturbances in the grid, which can damage grid mechanisms and power generation units. The power flow on this type of micro grid can be via AC (alternating current) or DC (direct current). For DC type loads such as electric and hybrid vehicle charging stations, it is advantageous to develop a DC grid to reduce the charging time by reducing the number of power electronic This paragraph of the first footnote will contain the date on which you converters [1-5].

EXISTING SYSTEM

An adaptive power management strategy (PMS) based on the equivalent fuel consumption minimization strategy (ECMS) for a four-mode HEV. The four modes HEV which consists of an ICE and two motors provides four modes of operation, including electric vehicle (EV) mode, range extended (RE) mode, hybrid mode, and engine mode. The adaptive PMS is designed for charge sustaining such that the state of charge (SOC) can be maintained at a certain value. A self-organizing fuzzy controller (SOFC) is employed to adaptively adjust the equivalence factor of electric energy consumption based on the SOC deviation and the change of SOC deviation. An instantaneous cost function which consists of the fuel consumption of ICE and the equivalent fuel consumption of the battery is minimized to obtain

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the optimum power distributions of the ICE and two motors. Simulation results show that the adaptive PMS can effectively improve the fuel economy for different driving cycles [6-9].

PROPOSED MODEL

It comprises of a control and monitoring center, a smart protection system, a stability control system, a measurement system to regulate the power flow on the micro grid. The smart micro grid transmission system is the part between the energy sources (wind, solar, fuel generator, energy storage system) and the load (EV charging station). The smart grid uses the control, protection, computer technology and communications to transmit the energy with high reliability. The smart grid incorporates the renewable energy generations and storage options and enabling new services such as vehicle grid energy flow. It is categorised to increase reliability of power applications such as voltage regulations, power efficiency etc. The energy storage system is one of major component of the smart grid. Transmitting renewable energy effectively into grid requires energy storage system that stores large amount of energy, M ion and s.

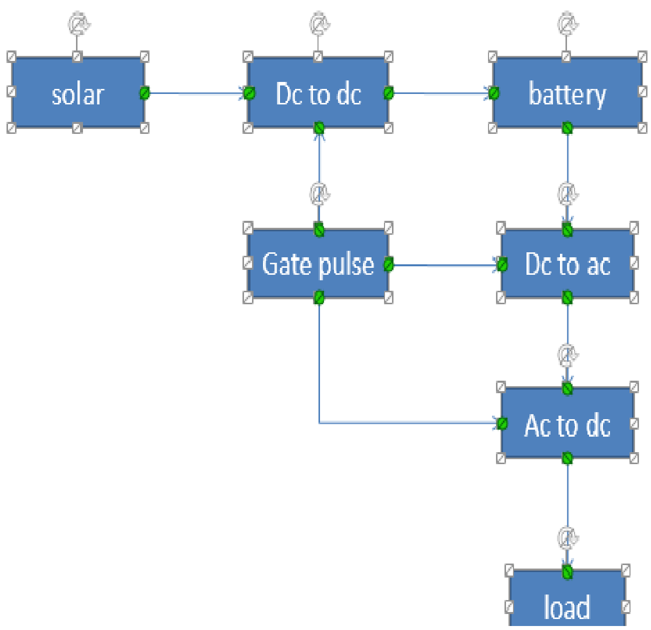

Fig 1. Block diagram of proposed system

RELAY

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized.

DC TO DC CONVERTER

A DC-DC converter is an electronic circuit that is used to convert a source of direct current (DC) from one voltage level to another. These offer a method to increase voltage from a partially lowered battery voltage saving space. DC to DC converters also regulate the output voltage.

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RESULT

The aim is to enable the design of an electrical control system that develops the correct duty cycle to stabilize and regulate the voltage at the DC/DC power conversion station.

CONCLUSION

A smart DC micro grid is proposed that connects fluctuating renewable energy sources such as wind and solar to electric vehicle charging stations on a grid that is separate from the national distribution grid. The aim is to avoid power flow issues such as transients, voltage reductions, harmonics and losses at the existing UK national transmission system. The smart grid includes energy storage systems to supply power to the grid during higher energy demands and when the renewable sources are not producing enough energy. The advantages of an independent DC micro grid are that it reduces charging time for electric and hybrid vehicles, has lower line losses due to shorter lengths and requires fewer power converters.

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