Decentralized energy management strategy based on predictive controllers for a medium voltage direct current photovoltaic electric vehicle charging station

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Abstract
The use of distributed charging stations based on renewable energy sources for electric vehicles has increased in recent years. Combining photovoltaic solar energy and batteries as energy storage system, directly tied into a medium voltage direct current bus, and with the grid support, results to be an interesting option for improving the operation and efficiency of electric vehicle charging stations. In this paper, an electric vehicle charging station supplied by photovoltaic solar panels, batteries and with grid connection is analysed and evaluated. A decentralized energy management system is developed for regulating the energy flow among the photovoltaic system, the battery and the grid in order to achieve the efficient charging of electric vehicles. The medium voltage direct current bus voltage is the key parameter for controlling the system. The battery is controlled by a model predictive controller in order to keep the bus voltage at its reference value. Depending on the state-of-charge of the battery and the bus voltage, the photovoltaic system can work at maximum power point tracking mode or at bus voltage sustaining mode, or even the grid support can be needed. The results demonstrate the proper operation and energy management of the electric vehicle charging station under study.

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