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E-MOBILITY AND POWER DISTRIBUTION SYSTEMS

Local Intelligent Transactional Energy Node for EV charging and Mobility Hub

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SUMMARY

In the last ten years, our company developed and provided energy conversion equipment that makes possible today the power flow management in a microgrid. In the present context, this experienced background is really a key to meet the today EVs charging challenge. Though the AC power grid has not been designed and set up for such energy transfers, an intelligent combination with local renewable sources and energy storage can address the increasing need of electrical energy while considering the latest worldwide policies to limit global warming and its carbon neutrality requirement. Even if such evolutions have already induced a modification of the electrical grid management, uncertainty on the production, growing EV charging demand as well as mismatch between production and consumption could quickly lead to big problems on the power network. Congestion issues and frequent blackouts are to be expected because EVs draw large currents from the grid to charge their batteries. Besides, reinforcing the grid would be very long and costly and from that increasing demand, new ways to locally manage electrical power emerge. With the high-power peaks to come due to EVs charging, the grid is likely to become non-resilient. So, the multiple converter system on below diagram presents high efficiency DC distribution to EVs and means to support the grid on request. This flexible set up will support the coming EV wide expansion.

This white paper aims to demonstrate how a combination of those different 3-port converters can balance the electrical network while managing local renewable sources, local battery storages and charging car terminals. Those triple converters, bidirectional on each port, have two different executions, AC/AC//DC and AC//DC/DC, where the AC acronym designates a single or triple phase port & the symbol // meaning "galvanic isolation". They introduce both new energy routing tools for local micro-grid applications like progressive power control from one power port to the two other ones, ie, the AC output of the AC/AC/DC system can drive a 100kW AC tri-phase load while taking 30kW on second AC port that could be the AC grid or a genset and 70kW on the DC port connected to a battery. Those converters can be parallelized to give a practical power scalability when the need increases over time. The AC/AC//DC topology has been initially developed to secure critical loads while the AC//DC/DC has been designed to manage a 3-phase port in grid following mode or in grid forming mode as well as renewable energy and battery on the two other DC ports.

This tandem of triple converters gives a lot of possibilities to route energy from one port to any other one, ie, in the described set up, from one charged battery set at a given car voltage to another partially discharged battery set at another car voltage. Other functionalities of triple converters are peak-shaving, maximization of self-consumption, demand response, grid support, power booster and pure power supply with uninterruptible features when critical loads are part of the local load. Thanks to a new microgrid concept based on the CE+T power fusion patented distribution model, all the distributed batteries on a DC micro grid can be considered and used as a global mutual single storage or individual local storage. On a 24x7 approach, those grids, seamlessly transferring energy between AC & DC buses, implement EVs charging at different car voltage requirement along with grid power support possibilities.