National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Co-ordinated Control of a Triple Active Bridge Interlinking Converter for Hybrid Microgrid with EV Charging Facility
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Venue	: EE Seminar Room (EE 401)
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Abstract

: The depletion of natural resources and the intermittency of renewable energy resources have pressed the need for a hybrid microgrid (HMG), combining the benefits of both AC and DC microgrids, minimizing the overall shortcomings and increasing the reliability of the system. Moreover, the transportation sector is undergoing a significant transformation with an increasing focus on electric vehicles (EVs) due to lower operating costs and better fuel economy with reduced carbon emissions. Hence, to reduce the ever increasing concerns on the energy issues and greenhouse gas effects, integration of EV charging station in hybrid microgrid improves the overall performance. However, the un-coordinated power flow in HMG and the uncontrolled charging of EV batteries lead to inefficient utilization of energy sources connected to HMG. The co-ordinated and controlled power flow along with the power management between individual ac and dc subgrids can be achieved by employing an interlinking converter. Therefore, with co-ordinated control, bidirectional power flow capability and galvanised isolation a Triple Active Bridge (TAB) interlinking converter is used to interface the sub-grids. The TAB has three windings, and the individual windings deals with power exchange from each subgrids and for the EV charging station. Before implementing a TAB based interlinking converter a dual active bridge converter (DABC) can be used for power flow control between two DC sub-grids. Due to bidirectional power flow potentiality, galvanized isolation, high power density with less passive elements DABC is extensively used in DC microgrid and battery charging applications. This work deals with the constant current (CC) charging of the EV battery using a DAB converter. Even though single phase shift (SPS) control is the most widely used control technique, it has the drawback of having more backflow power, which decreases the efficiency due to the increase of the switching stresses. A DAB converter is designed and simulated using an extended phase-shift (EPS) modulation technique to achieve zero backflow power. The detailed analysis and operation of EPS control with CC charging are delineated. Closed loop simulation results for a 1 kW, 96 / 48 V EPS based CC controlled EV battery charging system are presented, which explains the enhanced system performance with zero backflow power. Additionally, a TAB converter is designed and simulated in open loop mode to charge the multiple EV batteries. A triple phase shift (TPS) modulation technique is used for power transfer between the input/output ports with a reduced backflow power. Simulation results for a 2 kW, 150 / 96 / 48 V EV battery charging unit justify the improved performance of the TAB converter with reduced backflow power. The developed DABC with SPS and EPS modulation techniques is experimentally verified in open loop condition using TMS320F28379D microcontroller to charge the EV battery. The experimental results verify the better permance of DABC using EPS modulation technique with lesser backflow power for the EV battery charging application.