Abstract

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Bi-Directional Power Management Over Distributed Generation Battery-Less AC/DC Hybrid Micro-Grids

This thesis proposes the use of a three-phase power converter setup with suitable controller, for power flow management over a hybrid micro-grid (including AC and DC grids), without need to any permanent storage systems (batteries fuel cells) on the DC bus to counteract their high cost, complexity of design and integration. Such proposed system is capable of serving low voltage residential and commercial loads, where there would be an availability of renewable energy sources and possible DC loads (heaters, LED lights, electronics, etc …). Bidirectional power transmission is achieved between AC and DC buses through a three-phase bi-directional converter whose primary objective is to maintain a constant DC bus voltage with respect to DC sources loads change. A proportional integral controller is utilized to stabilize the reference DC bus voltage by varying the reference AC grid side current that is controlled by a hysteresis controller. Also automatic coupling of a three-phase synchronous generator to the infinite bus AC grid has been discussed and studied, analytically and practically as a case study, to deepen the concept of distributed generation. The experimental set has been tested for contributing to the AC grid, with direct active and reactive power control. Through MATLAB® SIMULINK® simulation analysis, practical results and based on digital signal processor, the proposed prototype setups have been evaluated for different operation scenarios.