Title: "Grid Power Quality Compensation – The Role of Flywheel Energy Storage Systems"

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Instantaneous mismatch of real and reactive power, between load and generation sources in electrical grids, is reflected in the quality of power delivered to end-users in many electric systems. The author presents a novel way to improve the instantaneous balance of real and reactive power. These regulation functions are acquiring greater importance as distributed sources are growing in percentage of all generating assets in electrical systems around the world. Relatively small and/or isolated systems are particularly vulnerable to generating sources with varying output energy flow.

FACTS devices have been utilized to inject/absorb reactive power; limiting its operation to the vertical axis of the four-quadrant plain. Using today's flywheel energy storage technology at a discrete level, the author presents a system design to achieve MW output/input levels at an electrical grid interface - therefore enabling four quadrant operation.

The technical feasibility of combining the best features of flywheel energy storage with proven developments in high-power electronics for energy storage and delivery is validated. Two system-level configuration options are discussed: Building enclosed - where strings of flywheels compose the matrix, which are installed in a building along with the power conversion system; and, Self-enclosed – a system-modular approach where an array of flywheels and power conversion electronics are packaged in a standard-size shipping container to be dispatched for grid stabilization or load support.

This technical proposal also includes a range of innovative ways in which this "four-quadrant" operation approach impacts distributed generation growth. Also, it breaks down some of the paradigms of what the new generation of flywheels can and can't do. Flywheels should not be viewed as replacements for batteries; flywheels and batteries are complementary technologies. In hybrid solutions each energy storage technology can contribute to performance according to its own relative strength. Flywheels, for example, can extend the life a BESS by taking the cyclic content.