Energy charging and storage systems for intelligent mobility

In their mobility concepts, cities and municipalities are focusing more and more on improving efficiency while reducing energy consumption and cutting CO₂ emissions. Siemens Rail Electrification is supporting this trend in public transport with its energy storage systems for trams. To meet this need, Siemens has developed the Sitras SES stationary energy storage system, the Sitras MES mobile energy storage system, and the hybrid version Sitras HES.

The Sitras SES stationary energy storage system provides the basis for the recovery of electrical energy in urban public transport. It operates parallel to the existing traction power supply system and is based on double-layer capacitor technology. Siemens delivers the stationary energy storage system ready for connection. It is configured for installation in existing or new substations in four double cabinets. On request, the Sitras SES can also be delivered ready for operation in a standard 20-foot container. The storage system can be directly connected via a terminal unit consisting of disconnector, high-speed DC circuit breaker, and pre-charging device to the traction power supply system or to the busbar in the substation. The connection between the terminal unit and the capacitor banks is established using a standard vehicle converter operating as a step-up and step-down converter. In “Energy saving” mode, braking energy is absorbed, stored, and released again during acceleration. In “Voltage stabilization” mode, the charging level stays continuously high, and energy is only released when the system voltage drops below a defined limit value.

Sitras MES mobile energy storage systems in which double-layer capacitors are used as storage elements are similarly employed for the recovery and utilization of braking energy from rail vehicles. Siemens has also developed a hybrid version, Sitras HES, that can be retrofitted in electric and diesel-electric vehicles. The energy
saving potential of this storage system can be as high as 30 percent, with up to 80 tons fewer CO₂ emissions per year per storage unit.

In the case of rail vehicles equipped with the hybrid system, the control in the energy-efficient operating mode can be adjusted so precisely that an optimal level can be achieved in terms of energy savings and capping of peak power. The hybrid system can be integrated not only in new rail vehicles but also in existing vehicles, and even those of other manufacturers.

The hybrid concept of the Sitras HES energy storage system combines the strengths of energy storage systems based on double-layer capacitors (lower storage capacity but rapid charging and discharging) with the advantages of an efficient lithium-ion traction battery (longer charge and discharge times but higher storage capacity). Double-layer capacitors are extremely efficient and have a highly dynamic charging/discharging capacity, a very high cycle stability, and a long service life. Rail vehicles equipped with this storage combination are capable of operating for distances of up to 2.5 kilometers without a catenary. The energy storage systems are recharged with recovered braking energy and at the same time can be “refilled” again very quickly by stationary charging stations. The charging process for 3.2 kilowatt hours of energy takes about 20 seconds.

This makes it possible to implement operation without overhead contact line for public transport systems with the Sitras HES hybrid energy storage system that can be integrated into any cityscape. The system is also suitable for structural conditions in which overhead contact wires cannot be easily installed, for example, in tunnels, over bridges or large crossings, and in front of EMC-susceptible buildings like hospitals and university laboratories. It is also possible to remove visually obtrusive overhead contact lines in order to enhance the cityscape. Siemens is using this hybrid energy storage system for the first time in the vehicles of a new tramway system that the company is currently building in Doha, the capital of Qatar. Thanks to Siemens’ storage and charging technology, the entire tram system can operate without an overhead catenary system.

Energy storage systems that operate without a continuous power supply can be used not just in rail vehicles but also in applications like plug-in hybrid buses and all-electric buses. Charging stations along the route and at the terminuses supply the
necessary energy while the vehicles are in operation. During the charging process, a moving contact arm mounted on a mast is lowered onto contact rails on the roof of the bus. A charging capacity of up to 450 kilowatts fulfills the energy requirement of electric buses and plug-in hybrid buses even in demanding operating conditions in city traffic. Volvo and Hamburger Hochbahn (Hamburg transport operator) have been working together in a development partnership since May of 2014 to test plug-in hybrid buses in Hamburg. Four high-performance charging stations have been built for this purpose. The technical partner for the charging technology is Siemens.

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This Background Information is available at:

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