Siemens – one of the leading supplier in the world of rail electrification solutions

Siemens has integrated its business on intelligent power grids into the Smart Grid Division, which is part of the Infrastructure & Cities Sector. Headquartered in Nuremberg, the Division has around 9,000 employees worldwide, and sites in more than 85 countries. The global market leader for years in the field of energy automation, the Division supports its customers in the installation and development of intelligent transmission and distribution grids, as well as in the integration of centralized and decentralized energy sources.

One of the Division’s strategic focus areas is to support customers in the modernization of the existing network infrastructure, allowing them to take advantage of the growing number of renewable energy sources and efficiently integrate them into the grid. Among their most notable customers from the developed and the developing markets are energy producers, network operators, industrial plants, energy suppliers, municipal utility companies and rail operators.

The Division is stepping up the expansion of its portfolio, which includes products, solutions and services for the planning, protection, automation and control of power grids, monitoring and diagnostics. Since October 1, 2011, it has also included products, solutions and services for rail electrification.

The Rail Electrification business unit is one of the leading providers in the world of rail electrification solutions. Whether it be for mass transit or main-line systems, or industry applications, Rail Electrification offers a portfolio of products, systems and solutions for traction power supplies, overhead contact lines and network control technology. Also included are electromechanical overhead contact line components, process and control technology, as well as energy-efficient inverter and energy storage systems.
The Rail Electrification business unit also combines comprehensive engineering expertise in the fields of civil engineering, construction, mechanical engineering, electrical engineering, electronics, and telecommunications with customized software for operational simulations. System design and calculation of rail electrification are among its core areas of expertise.

Product and system examples of solutions for constructing smart and energy-efficient traction power supply networks:

- With its Sitras Sidytrac simulation software, Siemens uses a program for implementing network calculations and train-travel simulations. It allows traction power supply systems to be compared under realistic operational conditions and enables new or existing systems to be configured and their performance studied.

- The Vicos RSC network control system, for example, integrates diverse SCADA applications (Supervisory Control and Data Acquisition) in a control and monitoring system. In addition to providing an overview of the operating status of the traction power supply system, it also provides a means of controlling energy consumption in the system and stabilizing operating processes through a fault and maintenance management system.

- The Sitras TCI power inverter enables braking energy to be transmitted from vehicles to the higher-level medium-voltage system. This makes it possible to bridge long distances and supply remote consumers, while the inverter’s thyristor technology ensures the necessary energy efficiency. The inverter can also be configured and controlled and diagnostic tests performed via a standardized communications interface, regardless of the operator’s location.

- The Sitras SES stationary energy storage system lays the foundation for recovering electrical energy within the mass transit network. In “energy saving” mode, braking energy is captured, stored, and delivered for acceleration. In “voltage stabilization” mode, the charging level is kept constant and energy is only delivered if the system’s voltage drops below a defined threshold. The primary energy requirements of a vehicle can be reduced by up to 30 percent through the storage of braking energy in stationary energy stores. The
energy saving potential amounts to as much as 500 MWh annually per storage unit.

- **Sitras MES mobile energy storage devices** and the hybrid version **Sitras HES** can also be used for recovering braking energy, and can be retrofitted in electric and diesel-electric vehicles. The energy saving potential from these devices can amount to as much as 30 percent, with up to 80 tons of CO₂ emissions conserved annually per storage unit. The Sitras HES energy storage systems’ hybrid concept combines the advantages of the ultracapacitor storage technology with the capabilities of a traction battery. This allows mass transit systems to be implemented without an overhead contact line, which not only cuts energy costs, energy consumption, and CO₂ emissions but also enables aesthetic transport systems to be integrated in any city environment. Operation without an overhead contact line is possible for distances of up to 2.5 kilometers with the hybrid system.

- Siemens offers the **Sitras SCD voltage-limiting device** with a mixed-voltage function. This function prevents impermissible voltages occurring in DC railway traction power supply systems if they are influenced by AC systems. The mixed-voltage function meets all requirements in terms of protective measures as laid down in the standard 50122-3, in order to avoid the incidence of impermissible mixed voltages.

- With the **Sitras SFC plus**, Siemens has developed a static frequency converter to transform the three-phase AC current from the public supply system directly into the single-phase AC current of the railway network with altered frequency. The system consists essentially of a single converter that directly couples both networks. These converters use a newly developed technology known as MMCD (modular multilevel direct converter). They can be matched to the required supply power on a modular basis, and can be used with power ratings between 12 and 120 MVA. In contrast to the externally commutated direct converters formerly used, self-commutated MMDC converters transform the energy with virtually no system perturbations. Noise emissions and space requirements are also lower with Sitras SFC plus modular multi-level railway converters compared with earlier converter solutions.

- An active **reactive power compensation system** ensures better voltage quality in the network. The system is based on voltage-sourced converter
technology and can be steplessly regulated using high-power transistors (IGBT). It improves voltage quality and stability in traction power supply networks. In the same way as with the Sitras SFC plus traction power converter, the core of the reactive power compensation system consists of its modular multilevel converter technology. Consequently, the voltage waveform generated by the system is also nearly sinusoidal. This means that the low-frequency harmonic filters necessary in previous solutions are no longer needed and the space requirement of the system as a whole is considerably reduced. The converter consists of a large number of capacitive voltage sources connected in series, hence the name multilevel voltage-sourced converter. These series-connected voltage sources act like a voltage divider which builds up the sine voltage.

Current Projects:

- **Siemens electrifies rail rapid transit line in Lima, Peru:** In 2013, the Tren Urbano rail rapid transit line in the Peruvian capital of Lima is due to be extended. This high-level extension will run along a viaduct and cover a distance of approximately twelve kilometers. Siemens Smart Grid will be responsible for electrifying the entire section of track, and this will help it to build on the success it is already enjoying on the Peruvian market. Siemens will be responsible for electrifying the entirety of the new double-track metro line, which is to run from the northern suburbs of Lima right through to the historic downtown area and will include ten stations. The remit will involve providing a feeder station (60 kV/20 kV) with two 20 MVA transformers, two 20 kV cable distribution system rings, as well as ten station supplies and four 1500 V rectifier substations. In addition to the double twelve kilometers long catenary line running along the actual route, the order also covers the installation of a 2.6 km overhead contact line system for the planned depot. On top of that, a Scada (supervisory control and data acquisition) system is to be implemented for the purpose of monitoring and controlling the traction power supply.

- **Siemens electrifies first rail rapid transit line on Hawaii:** Hawaii's first rail rapid transit system is due to be built in Honolulu by 2019. Siemens Smart Grid has received a multi-million US dollar order to electrify the entire track. The new rail rapid transit system will run alongside Honolulu's 32-kilometer
long main arterial road, which is being stretched to the limit with current levels of automobile traffic. The rail rapid transit system will provide much needed relief and connect the East Kapolei district in the west with the Ala Moana district in the east, taking in Pearl Harbor and Honolulu Airport.

- **Siemens to modernize traction power supplies for rail rapid transit lines in São Paulo:** Siemens Smart Grid is to modernize the traction power supply network of several rail rapid transit lines in São Paulo by 2015. The customer is Brazilian commuter rail operator Companhia Paulista de Trens Metropolitanos (CPTM). The 187-kilometer-long rail rapid transit network connects the central station and the district of Brás, near to the city center, with a number of suburban areas. Siemens' share of the overall contract is roughly USD44 million.

- **Siemens receives orders for static frequency converters from Sweden and Switzerland:** To strengthen the traction power supply networks in Sweden and Switzerland by establishing additional links to the public power supply grid, Siemens Smart Grid will supply Sitras SFC plus static frequency converters to Swedish Transport Administration and to Swiss Federal Railways (SBB). The order volume for both projects amounts to approximately EUR60 million. The orders include the delivery, installation, and commissioning of eight multilevel direct converter blocks in Sweden and two converter blocks in Switzerland. The systems use state-of-the-art multilevel power converter technology, which makes it possible for them to convert energy highly efficiently and with almost no system perturbations. In addition, they are quieter than conventional systems and have a smaller footprint.

- **Siemens installs network interconnection between ÖBB network and public power grid:** In order to increase the efficiency of its traction power supply grid, the Austrian Federal Railways (ÖBB) have commissioned Siemens Smart Grid to install a static frequency converter from the Sitras SFC plus series as a network interconnection in the Stubach valley near Salzburg. The order was placed by ÖBB-Infrastruktur AG in Vienna and is worth about eight million euros and includes delivery, installation and commissioning of the converter with an output of 48 megawatts (MW), the converter transformers and the auxiliary equipment. This is to provide a network interconnection between the 16.7-Hz traction current system of Austrian Federal Railways
ÖBB) and the public power supply grid (50Hz) in addition to the existing six network interconnections. The converter is being installed within the grounds of the existing hydroelectric power plant at Uttendorf in the Stubach valley and should enter service in the fall of 2014.

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The Siemens Infrastructure & Cities Sector (Munich, Germany), with approximately 90,000 employees, focuses on sustainable technologies for metropolitan areas and their infrastructures. Its offering includes products, systems and solutions for intelligent traffic management, rail-bound transportation, smart grids, energy efficient buildings, and safety and security. The Sector comprises the divisions Building Technologies, Low and Medium Voltage, Mobility and Logistics, Rail Systems and Smart Grid. For more information, visit http://www.siemens.com/infrastructure-cities

The Siemens Smart Grid Division (Nuremberg, Germany) offers power providers, network operators, industrial enterprises and cities an end-to-end portfolio with products and solutions to develop intelligent energy networks. Smart Grids enable a bidirectional flow of energy and information. They are required for the integration of more renewable energy sources in the network. In addition, power providers can run their plants more efficiently with data gained from Smart Grids. Software solutions that analyze data from Smart Grids will continuously gain importance. Thereby, the division uses in-house developments in addition to systems from software partners. For further information please see: http://www.siemens.com/smartgrid