

High Voltage for an Advancing Country

Russia, the largest country on earth, also has one of the world's largest electricity networks, with 2.6 million kilometers of transmission lines and over 18,000 substations around the country. But the energy infrastructure, most of which dates from Soviet times, will need to be modernized soon, since experts predict that Russian electricity consumption will double by 2030.

By Moritz Gathmann

In the middle of shopping centers and 20-floor apartment buildings in the north of Moscow, High Voltage Side Street branches off left from Rymsky-Korsakov Street. House number 5 explains the strange name of this road: It is Beskudnikovo electrical substation, one of the big electricity transit stations that, together with many smaller substations, has formed the electricity ring around Moscow since the 1950s. The hall is filled with a low hum coming from the Ukrainian-made transformer next door, as the high-voltage energy flows in from the various power plants that feed the buzzing Russian capital's hunger for energy. Two big halls contain a 110-kV, a 220-kV and a 500-kV gas-insulated switchgear (GIS), made by Siemens and installed over the last few years, since it was decided in 2005 to

renew the worn-out Soviet substations around the 12-million metropolis.

Substations for Russia's "Silicon Valley"

The high-voltage supply of the Russian capital is managed by the Joint-Stock Company Federal Grid Company of Unified Energy System (JSC FGC UES), a mostly state-owned company that owns and operates 120,000 kilometers of transmission lines and 796 substations all over Russia. "When it comes to the reliability of its equipment, Siemens is certainly one of the leading companies," says Deputy Chairman Dmitry Gvozdev. The newly signed agreement makes the cooperation even closer, he adds. FGC UES now also has a service agreement with Siemens. Gvozdev is especially satisfied with the cooperation in this field:

"In terms of service, Siemens is ahead of its competitors." A smaller, but nevertheless challenging project for FGC UES is the electricity substation for Skolkovo. The village in the vicinity of Moscow is to become the Russian counterpart to Silicon Valley in the coming years. Siemens will contribute an underground substation – which is a novelty for Russia. FGC UES is relying on the German company's experience with similar projects in the USA and Switzerland. FGC UES's next challenging project in cooperation with Siemens is a 220-kV high-voltage GIS at the Krasnoyarsk Aluminum Plant (KRAZ) in the Siberian town of Krasnoyarsk.

Partner in a Historic Modernization Effort

Siemens has achieved similarly good relations with the Moscow United Elec-

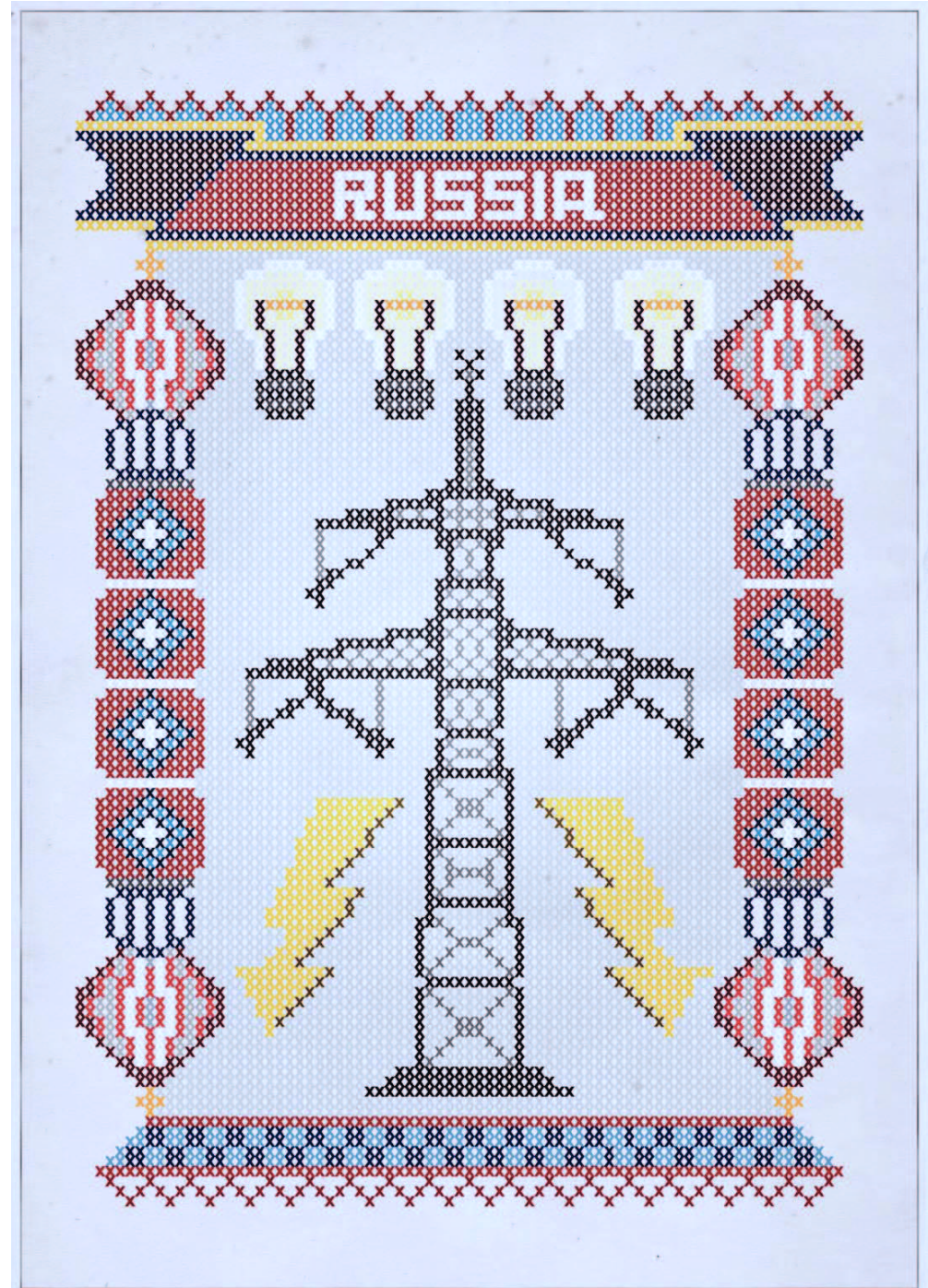


Illustration: Christoph Ohnenian



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tric Grid Company (MOESK), which owns the energy transmission network of the Russian capital and the surrounding region. Siemens has delivered 26 gas-insulated stations on the 110- and 220-kV level to MOESK over the last five years. With a volume of US\$1,200 billion, Russia's energy market today is as big as that of Brazil. But the World Energy Outlook 2010 predicts it will experience a growth rate of 7 percent by 2015, which is one of the highest in the world. Russia's energy transmission sector in particular offers great opportunities for foreign producers of energy transmission equipment. According to the Russian Ministry of Energy, 22.8 percent of the lines have been in use for more than 50 years, although their designed operation life was only 25 years. There is a similar situation with transformer stations: 51.1 percent have already exceeded their stated operation life of 25 years. The state of the network's circuit breakers is just as bad. As a consequence, in 2009, a record volume of approximately 11 percent (or 92,440.9 million kWh) of electricity produced in Russia was lost during transportation.

This inefficiency in the energy sector flies in the face of the government's modernization plans. According to official assessments, the population of Russia will use 85 percent more electricity in 2030 than in 2005. To tackle this challenge, the Ministry of Energy recently presented an energy strategy that envisages a duplication of Russia's energy generation by 2030 to 2,210 billion kWh. Russian state-owned companies and private energy suppliers will not only invest tens of billions of rubles in new energy production facilities annually, but also contribute funding for energy-efficient modernization of buildings, transmission networks, and substations. The mostly state-owned FGC UES alone is investing approximately US\$28 billion in the modernization of its network in the period 2010–2014.

One of the most interesting projects in the last years has been the construc-

tion of the Mutnovskaya geothermal power plant on the Kamchatka peninsula, 7,000 kilometers east of Moscow: Siemens contributed a 220-kV GIS system to the project, which was run by RusHydro, the largest Russian hydropower company. By the time it was completed in 2002, it was one of the most ecological and modern geothermal plants in the world. Moreover, it lessened the dependence of the inhabitants of oil, which has to be imported by land and damages the ecology of this peninsula, famed for its



Gas-insulated switchgear (GIS) for 500 kV in Beskudnikovo substation. GIS installed by Siemens is a key element in the historic modernization effort.

fascinating landscape and wildlife. The special challenge in the project was the construction of a GIS system that can cope with the seismic activity and the sulfurous atmosphere around the plant.

Siemens as a Supplier of Turnkey Solutions

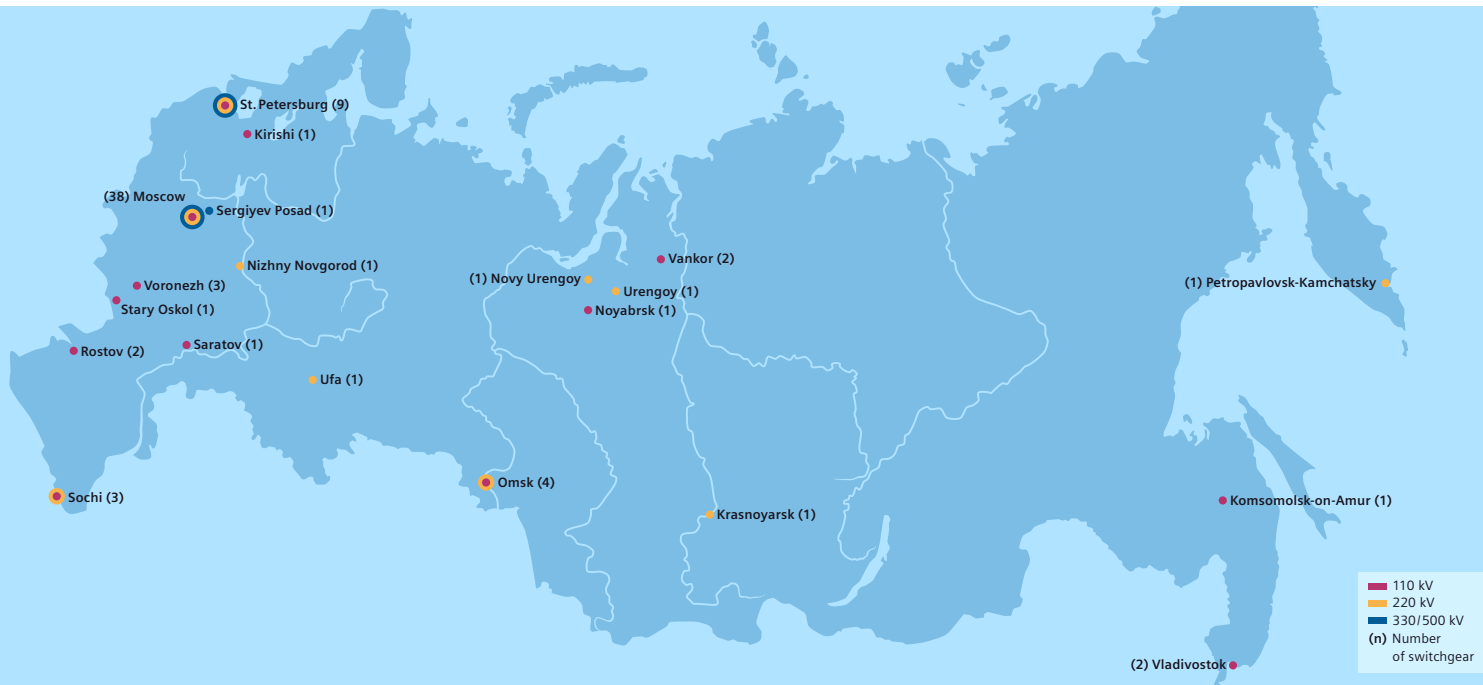
In neighboring countries such as Kazakhstan, Azerbaijan and Turkmenistan, Siemens is already well-known as a supplier for turnkey solutions. In Siberia, it has built three complete

Photos: Kirill Ovechinikov

Summary

■ The Russian energy market is worth US\$1,200 billion annually, and its expected growth rate of 7 percent is one of the highest in the world. The rapidly developing economy needs not only energy, but also the equipment to transmit and distribute it: Most of the existing substations and transmission lines were built in Soviet times and have to be modernized in order to reduce the high energy loss during transportation. The Federal Grid Company (FGC UES) alone is investing approximately US\$28 billion in the modernization of its network in the period from 2010 to 2014. Siemens is part of this historic modernization effort, delivering high-voltage gas-insulated switchgear and complete substations, and has signed cooperation agreements not only with FGC UES, but also with regional energy distributors and suppliers such as Omskenergo. To strengthen its position, Siemens is localizing production: After opening an assembly center for medium-voltage equipment near Moscow in 2010, the company is building facilities for transformers, high-voltage GIS, and circuit breakers in the Russian city of Voronezh.

GIS Stations Across Eight Time Zones



Siemens gas-insulated high-voltage switchgear can be found across the territory of Russia – at voltages ranging from 110 kV (red) to 220 kV (yellow) and 330 or 500 kV (blue).

110-kV stations for regional energy supplier Omskenergo, which included engineering delivery, supervision of installation and commissioning of switchgear, protection, and the control system. The civil works were carried out by Omskenergo. The positive experience with the first project in 2004 convinced Omskenergo to sign a cooperation agreement in 2007, says Sergey Modenov, director of Omskenergo, which supplies energy to the 141,000 square kilometers of Omsk region. The Siberian city with its more than one million inhabitants is quickly developing, and new energy is not only needed for the subway under construction, but also for a

newly constructed urban district on the left side of the Irtysh River. In 2011 and 2012, Omskenergo will invest some US\$140 million in reconstructing Soviet-era substations and building new ones. “As our region is developing, the annual investments in the years after 2012 will be even bigger,” says Modenov. The regional energy distributor tried to cooperate with competitors, but decided to stick with Siemens after some bad experiences. “We are convinced that the Germans are reliable when it comes to meeting construction deadlines and their guarantee obligations,” says Modenov. Under the terms of the agreement, Siemens

will also share innovations with Omskenergo.

Localizing the Production

Siemens, which can boast of a 155-year presence in Russia, has developed trustful relationships with the key players over the past few years, and is on its way to play a key role in the upcoming historic modernization effort. To this day, there are some 400 bays of Siemens high-voltage GIS in Russia, from far-eastern Kamchatka to St. Petersburg, including the voltage range of 500 kV. In the city of Voronezh, 500 kilometers south of Moscow, Siemens is building three plants that will produce transformers, GIS sys-

Graphic: independent

tems, and circuit breakers, investing US\$70 million and creating more than 600 jobs. The first plant, scheduled to start production in 2011, will produce as many as 100 transformers a year. In Moscow, meanwhile, Siemens is opening an engineering center with 30 highly skilled German and Russian professionals who will develop solutions for its partners in Russia. Having production facilities in Russia makes Siemens more competitive: “For the next substations, we are planning to buy the transformers from Siemens, too,” says Modenov of Omskenergo. Imported transformers were too expensive. The opening of the engineering center and the plants in Voronezh as well as

the developing relationships with key companies in the energy sector put Siemens in a good position to become a partner for turnkey solutions in Russia as well. “The cooperation agreement makes it more likely that we will have Siemens as a partner for turnkey projects in the near future,” says Gvozdev of FGC UES. Apart from its business in high-voltage equipment, Siemens is also strengthening its position in the medium-voltage sector. In 2009, Siemens started production of gas-insulated medium-voltage switchgear in an assembly center near Moscow. Among other projects in heavy industry, in 2010 the plant delivered 56 (NX PLUS C) medium-voltage

feeders to Omskenergo. Alfred Ebner, Head of the Siemens Energy Transmission department in Moscow, is optimistic: “Localization is a cornerstone for cooperation in the Russian transmission and distribution networks and the basis for our further development in Russia.”

Moritz Gathmann has been working in Moscow since 2008 as a correspondent for various German magazines and newspapers. His articles have appeared in Spiegel magazine, Süddeutsche Zeitung, Frankfurter Allgemeine Zeitung, and others.

Further Information

www.siemens.com/energy/hv-gis

Glossary

- **High-voltage substations:** High-voltage substations are important nodes within a power transmission grid. They transform the energy transmitted on high voltage levels to lower levels for further distribution. Specific switching operations control the power flow and ensure security of supply for end consumers. At the core of such switchgear are high-voltage circuit breakers that can switch even the highest short circuit currents safely.
- **Gas-insulated high-voltage switchgear (GIS):** Space-saving gas-insulated high-voltage switchgear (GIS) is the ideal solution for areas where available space is limited. Space requirements of GIS are about 50 times lower than those of conventional air-insulated switchgear. Compactness and modular design make possible the flexible use of GIS even in very confined spaces, such as the basement of high-rise buildings or historical buildings.
- **FGC UES:** The Federal Grid Company of Unified Energy System is the owner and operator of the electricity transmission grid in Russia. The company is mostly state-owned.