

Clean power boost in Central Europe

One of the newest members of the EU, Slovenia, continues to invest in a multi-billion-euro modernization program designed to meet its spiraling demand for energy. Siemens is installing two clean-burn, high-efficiency SGT-800 gas-turbine generating sets at the country's largest power plant in Sostanj.





The Block-4 unit originally supplied by Siemens in 1972.



Moored and ready for offloading

Slovenia is a small Central European country on the northernmost part of the Balkan Peninsula, with a total area of just 20,273 km², only slightly larger than the state of New Jersey in the US, and a population of around two million, fewer than in Paris, France. An Alpine country on the Adriatic coast, it is bordered by Italy, Austria, Hungary and Croatia. The most prosperous region of the former Yugoslavia, the country won independence in 1991, transforming its socialist economy to the capitalist free market. Slovenia became the only former Yugoslav republic to be in the first wave of candidates for membership of the European Union, joining both the EU and NATO in 2004 and on January 1st 2007 becoming the first new EU member state to join the eurozone. In the first half of 2008, Slovenia will take over the EU's rotating presidency.

Slovenia is a booming region whose economic performance has not only consistently outpaced its neighbors from within the former Socialist

Republic, but also many long-established members of the EU. The country's diverse geography boasts lakes, rivers and magnificent heavily forested Alpine scenery with snowy peaks rising to more than 2,800 meters, together with a mixture of coastal Mediterranean and continental climates. Combined with a rich cultural heritage and vibrant artistic scene, the many attractions of both its historic capital Ljubljana and its picturesque towns and villages are making Slovenia an increasingly popular destination for tourists.

National challenges

Despite Slovenia's undoubted economic success, the country faces a growing number of challenges. A large proportion of its economy, including the largest power utilities, remains under state control, although privatization programs have been in operation for a number of years. The very latest free-market legislation passed by the government now allows domestic consumers for the first time to choose their

energy supplier, with prices for gas and electricity being set by the supply companies instead of the State. Direct investment by foreign companies is among the lowest in EU countries, taxes remain high and industries are losing sales to more competitive companies in Asia. The country also has very limited primary energy resources of its own, importing virtually all its oil and gas by pipelines from Russia and to some extent Algeria. However, it does have proven reserves of low quality soft 'brown coal' or lignite amounting to some 190 million tonnes, equivalent to around 50 years of production at present rates of consumption.

Power under pressure

Although the general infrastructure throughout Slovenia is excellent, its power industry is coming under increasing strain. Slovenian generating facilities are split fairly evenly between hydro, nuclear and thermal technologies. However, thermal power generation is based principally on mature, 'brown coal' lignite-fired



SGT-800 accessories being lifted from ship to shore



The first of two SGT-800's at its port of destination, Koper, Slovenia.

technology and the majority of the thermal generating plants are either approaching or well past their operational design life. As the basic fuel burned in these power stations, lignite is widely regarded as a 'dirty' form of coal with a relatively low heating value and can include concentrations of up to three percent of elemental sulfur. In addition to significant quantities of ash, particulates and nitrogen oxides (NO_x), the combustion process also produces high levels of carbon dioxide.

Slovenia's burgeoning economic growth is leading to an equally powerful demand for electrical energy, the lifeblood of industrial expansion, with electricity demand growing at an annual rate of some three percent. Nonetheless, a shortfall in domestic generating capacity means the country has to import about 25 percent of its annual power requirement. The need to increase power production from existing facilities, coupled with the increasingly urgent requirement to bring emissions levels

from thermal power plants into line with statutory EU limits, has brought the need for modernization and upgrades into sharp focus.

Major players

By far the largest thermal power generating plant in Slovenia is located at Sostanj, a small town around 90 km northeast of the capital Ljubljana. Providing heat to a major part of the local district heating network in the adjacent Velenje area, as well as exporting bulk electrical power to the grid, the combined heat and power facility is rated at 745 MWe and 220 MWth with a net capacity of 683 MW, producing an average of 3,600 Gigawatt hours (GWh) of electricity and 450GWh of heat per year. This cogeneration facility is operated by Termoelektrarna Sostanj (TES), a wholly-owned operating subsidiary within the HSE group, a major Slovenian state-owned organization with interests throughout power industry, both in its home country and abroad. The largest power facility in the HSE group's portfolio, Sostanj

comprises five steam-turbine-based generating units and two separate dedicated district heating boilers. Power Blocks 1 and 2 are each rated at 27 MW, Block 3 is 68 MW, and the Siemens-built Blocks 4 and 5 are rated at 252 MW and 309 MW respectively. The plant supplies around one third of Slovenia's total power requirement and if necessary can meet more than half of the national demand. Originally designed for base load operation, the plant's efficiency is reduced visibly when the existing generating units are required to operate more flexibly under part load in response to fluctuating demand, a situation which will become an even greater problem when the power market becomes fully liberalized.

That sinking feeling

The boilers feeding the five steam turbogenerators at the plant, as well as the two heating boilers, are all fired on lignite from the nearby Velenje mine and consume an annual total of around 4,000,000 tonnes. Unlike the majority



of similar facilities which extract brown coal from open-cast mines, fuel for the TES plant at Sostanje is extracted at the Valenje pit by deep-mining techniques. The billions of tonnes of lignite mined over many decades in the locality using underground strip-mining has resulted in extensive surface subsidence, although the ground beneath the power plant itself remains undisturbed. The stacks, cooling towers and buildings at the plant, backed by a steep, densely wooded hillside, are reflected in the waters of large lakes which front the site. The tranquil appearance of the scene is deceptive, as the lakes are the direct consequence of the severe and obviously continuing ground subsidence, with several houses and a church now submerged in their depths.

Modernizing moves

Despite electrostatic precipitators and flue gas desulfurization systems, atmospheric emissions from the lignite-burning TES plant at Sostanj remain high. Accordingly, the holding company HSE is planning a 4-year program aimed at raising operating efficiency and environmental performance to conform to EU standards. At the same time, the modernization and upgrade program is also designed to increase both the power output and the operational flexibility of the Sostanj power plant to meet rising national demand. In 2005 Siemens was awarded a turnkey contract to supply and build a completely new cogeneration unit which would allow Blocks 1, 2 and 3 to be taken out of service and boost the output of Block 5 by around 85 MW. The gas-turbine-based unit will be supplied by a new natural-gas pipeline now nearing completion, which will provide a connection to

the main pipeline importing gas from Russia. Construction of the new cross-country pipeline has been a major project in its own right, requiring individual wayleave consents from nearly 400 separate landowners.

Clean green gas turbine technology

The new plant extension will be based on two SGT-800 gas turbines which have been manufactured at the Siemens factory in Finspong, Sweden, shipped to the Slovenian port of Koper, offloaded and transported to Sostanj by road. Each single-shaft SGT-800 has a 15-stage compressor and 3-stage axial flow turbine giving a rated output of 45 MW and a simple-cycle efficiency of 37 percent. The industry-proven, environmentally-friendly design incorporates an annular combustion chamber with 30 dual-fuel, DLE (dry low emissions) burners producing less than 15 ppmv of NO_x, less than 5 ppmv of CO₂ and no measurable SO_x when fired on natural gas, but with the capability of switching to No. 2 distillate as a standby fuel if gas supplies are interrupted. Representing the very first modern-technology machines of their kind to be used in Slovenia's power industry, the first of the two gas-turbine generator sets is currently being installed in the new building extension to the rear of the existing power plant, where it will operate as a highly flexible combined heat and power unit. Designed around a rather unusual concept, the new unit is indirectly coupled to the steam-cycle of the thermal plant. Heat from the gas turbine exhaust is extracted by a heat-recovery steam generator and used to pre-heat the boiler feedwater for Block 5. First firing is scheduled to take place in April 2008, and the initial system

is due to start full commercial operation in June. A second, identical SGT-800 cogenerating unit will be installed subsequently, doubling the electrical power output to provide an additional peak-power capability of around 84 MW and providing feedwater heating for the existing Block 4.

Fully flexible for the future

Having now reached the ripe old age of 35 years and with around 300,000 operating hours to its credit, the existing Block 4 steam turbo-generator, originally supplied and installed by Siemens in 1972, will ultimately be shut down and held in reserve, allowing both new SGT-800 gas turbines to provide feedwater heating for Block 5. This will allow both existing pre-heaters to be shut down, eliminating the need to extract steam from the steam turbine and raising efficiency still further. As well as providing a massive 3.6 percent improvement in overall thermal efficiency and highly flexible operation as a peak-opping plant, the new low-emissions natural-gas fuelled unit will reduce the thermal plant's lignite consumption by as much as 11 percent, thus cutting all emissions very significantly, including a reduction of CO₂ approaching 18 percent. As part of the overall project, Siemens is supplying and integrating all the controls as well as the ancillary systems for both the thermal plant and the new SGT-800 installation. With a close business relationship extending over nearly 40 years, Siemens and TES are together continuing to ensure the security of economic power supplies to meet future growth in Slovenia, with the application of modern, "clean green" energy technologies.

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