Venture
Into the World of Industrial Rotating Equipment
Issue 8 | November 2007

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All set to power the Indian market

Spotlight
BOG — A super-cool success story

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Dear Reader,

This issue of Venture is fully packed with information and insights into the world of rotating turbomachinery. We provide kaleidoscopic glimpses from selected projects from all over the world, from biomass plants for the Shakopee Indians of Minnesota, USA, to the local sugar and molasses industry of Mahashtra state, India. From the spiraling suburbs of the brand-new Moscow City business and residential center in Russia, to the horticulturally and politically blossoming mountain state of Slovenia in Central Europe.

And we do this via our range of turbomachinery. Whether state-of-the-art gas turbines powering major cities and industries, small predesigned steam turbines at the heart of cottage industries and decentralized power plants, or super-cool compressors for handling the gases associated with LNG transport, storage and re-gasification, these turbomachines have one essential element in common. They represent Siemens solutions custom-engineered to meet our clients’ individual needs. Power for you, powered by us.

In these pages we present Siemens Turbomachinery Equipment, the most recent addition to our business with a portfolio that perfectly complements and extends our previous range of compressors and steam turbines. And we introduce you to the BOG (boil-off gas) compressors which have become such a key part of the LNG supply chain.

So venture into our common world of industrial rotating equipment and enjoy your journey!

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Siemens will supply core equipment, including one synthesis-gas compressor and one propylene compressor, to the world’s first methanol-to-propylene (MTP) plant located in China.

To date, a total of 13 SGT-800 units have been sold to the Moscow region, providing power and district heating to the booming fringe around the Russian capital.

Fueled by 180,000 tonnes per year of biowaste, a SST-300 steam-turbine generator will deliver 16.5 MW baseload electricity to the Shakopee Mdewakanton Sioux Community in Minnesota, USA, and the local malting company, Rahr. Completion of the facility is expected within one year.

The lucky winner of the Leica V-Lux 1 digital camera: Suchat Nokputsa, energy and environment conservation engineer working for the Siam Ceramic Group of industries in Saraburi, Thailand.
World first in methanol-to-propylene compression
Siemens will supply core equipment, including one synthesis gas compressor and one propylene compressor, to the world’s first methanol-to-propylene (MTP) plant. It is located in China, some 400 kilometers north of Beijing, and will be operated by Datang International Power Generation Co. Ltd., one of the biggest energy suppliers in China. The plant has a planned capacity of 470,000 tonnes per year. The synthesis-gas compressor, a barrel-type STC-SV compressor, will be driven by a SST-600 extraction-condensation steam turbine and will be used to compress the synthesis gas from 31.7 to 86 bar. The propylene compressor is a horizontally split compressor (STC-SH), which will compress the propylene from 1.05 to 17.6 bar. The driver for this compressor will be a SST-600 condensing steam turbine with an output of over 40 megawatt (MW). The equipment is scheduled for delivery spring 2008. Propylene is one of the most important feedstocks for the petrochemical industries. The main derivate of propylene, polypropylene, has a projected consumption growth of five per cent per year. In the past, propylene has mainly been produced from crude oil, but in a recently developed methanol-to-propylene process, natural gas or coal can be used to generate methanol in the first step. In a second step, the methanol is converted to propylene.

Cogeneration consolidation in Russia
Siemens PG has recently secured an SGT-800 order in Moscow, Russia, covering three gas turbine generator units to be used in the Kolomenskoe GT Cogeneration Power Plant project. NaftaSib Energiya, Russian private investor and operator of the Kolomenskoe GT Cogeneration Power Plant project, is constructing the plant under contract with the government of Moscow City. The new plant, which will increase Moscow’s generating capacity, is due to come into operation at the end of 2008. Having sold a total of 13 SGT-800 units since 2001, Siemens has clearly achieved market leadership in the supply of turbines of this rating in the Moscow region. The SGT-800 gas turbine has now been launched with a new rating, which will reduce life cycle cost. From its mature output of 45 MW, the SGT-800 has advanced to a rating of 47 MW at 37.5 percent efficiency. The combined cycle performance has also improved to 66 MW with an efficiency of 54 percent. Specific components in the gas turbine are modified, and are fully interchangeable between the 45 MW and the 47 MW rating.

Siemens in unusual partnership
Siemens will deliver a 23-MW SST-300 steam-turbine generator to Koda Energy, the partnership between the Shakopee Mdewakanton Sioux Community (SMSC) in Minnesota, USA, and the local malting company, Rahr. The power plant will run on 180,000 tonnes per year of biowaste to provide 16.5 MW baseload electricity for the melting factory and the local community. The SMSC is a federally recognized Indian tribe whose people are direct descendants of the original inhabitants of the Lower Minnesota River. They have entered a partnership with the Rahr malting company in Shakopee, where the Rahr family has been making malt for 159 years. The Shakopee plant, which is the largest malting facility in a single location in the world, currently employs over 100 highly skilled workers.

In order to generate heat and electricity for the two partners, Koda Energy will build, own and operate a biomass-fueled CHP plant, for which at least 25 percent of the fuel will come from the factory by-products. The remaining fuels will be supplied through local agribusinesses, wood waste producers and dedicated energy crops.

In normal operation, the plant will produce 11.5 MW of baseload energy plus 125 million BTU per hour (36,700 kWh) of thermal energy. Rahr will purchase all of the heat generated by the system to replace its current use of natural gas. The electricity generated will enable the partners to avoid external energy costs, and any excess will be available to outside power purchasers in need of base-load and/or biomass renewable energy.

Reader survey prize goes to Thailand
Venture is delighted to announce that the lucky prizewinner of a Leica V-Lux 1 digital mega-zoom camera resulting from the random draw from the reader survey responses sent to us is Mr. Suchat Nokputsa, an energy and environment conservation engineer working for the Siam Ceramic Group of industries in Saraburi, Thailand. Congratulations, Mr. Nokputsa: we hope that you and your camera will enjoy some really good times together and create some amazing visual memories to gladden your days! Thanks from the Venture team to all those readers who took the time to answer our survey and give us such valuable feedback. You gave us some useful recommendations we will gladly develop over the coming issues.
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.
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.
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 (NOx), 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 Sostanj 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 NOx, less than 5 ppmv of CO2 and no measurable SOx 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 turbogenerator, 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 preheaters 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-lobbying 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.
Venture: Matjaz, the power station at Sostanj has obviously been here for quite some years, so can you give a brief outline of its development?

MD: Even before a power station was built on this site, electricity was being produced from a nearby facility as long ago as 1929. With an output of just 2 MW, this plant supplied the whole of the Velenje area. New equipment was added in 1939, increasing the output to 5 MW. With power demand rising rapidly after World War II, in 1952 a new lignite-fired thermal power plant was built here on the present site comprising two 30-MW power blocks; a third one with 75 MW was added in 1960. In 1972 a new Siemens steam turbogenerator with an output of 275 MW was commissioned and this is still in use today as Block 4. Five years later a second Siemens-built unit rated at 345 MW was added, giving us the present Block 5.

Venture: So business dealings between TES and Siemens stretch back for around 35 years, but how would you describe the present relationship between the two companies?

MD: Well, for my part I would say that we operate in an excellent partnership, recognizing each others’ strengths and using them to agree on solutions to problems as and when they appear. Ales Presern, the manager of the Siemens PG office in Ljubljana and one of our principal contacts here on this site has described the relationship as being “as good as it gets” and I can certainly go along with that.

Venture: You obviously have a really good working relationship, but surely that can't be the only reason for choosing Siemens as the supplier for this current project?

MD: Of course not, Siemens was up against some stiff competition, but past experience gave us a good degree of confidence in Siemens’ ability to meet our needs, both in terms of price and engineering technology. In fact the SGT-800 turbines were an exact match for our requirements, particularly with regard to their exhaust temperature, as it was absolutely critical that this should provide an alternative heat source for pre-heating the boiler feedwater.

Venture: And how is the project actually proceeding?

MD: Well, the civil works are nearing completion, the first gas turbine has arrived and the installation and erection is on track. The heat-recovery steam generator is being supplied by a manufacturer from the Slovak Republic and is almost finished, and the gas pipeline is nearing completion, so all in all, everything is on schedule.

Venture: And what about specific problems you have encountered — there must have been a few headaches?

MD: Naturally there are always problems to be overcome, but so far at least, this project has gone very smoothly. I suppose our biggest headache has been finding enough room to expand on this site. As you have seen, the existing generating blocks are squeezed between the Velenje mine workings at one end of the site and the town of Sostanj at the other, with a main road and large lakes forming a boundary to the front and a high and very steep hillside immediately behind us. The only way we could find the space to build the new extension was by excavating part of the hillside and constructing the buildings in this area.

Venture: And what about your plans for the future?

MD: Of course, we fully intend to maintain our leading position as Slovenia’s biggest power generating company and technical innovator, but we are also looking at expanding our operation at Sostanj still further. This will almost certainly involve demolishing some of our older existing facilities and building a completely new power block, so all I can say at this time is “watch this space!”

Partners in power

Matjaz Dvorsek, Project Manager at the TES power plant, is enthusiastic about his new ‘baby’ and was happy to take time out to give VENTURE some interesting insights into both the existing plant and the new project.
The Gujarat Prime Mover company was set up in 1986 at Baroda, India, specifically to manufacture single-stage, 1-megawatt turbines implementing the KK&K (Kuehnle Kopp & Kausch) technology. Today, when the robustly growing industrial sector in India is plagued with a deficit in power supply, the Vadodara Steam Turbine Factory, along with the newly acquired KK&K turbine business, spearheads the Siemens turbine manufacturing activities in India.
In 2006, Siemens celebrated 50 years of local manufacturing in India. To mark this historic occasion, Siemens Ltd., as part of its investment-led growth strategy, announced the establishment of a greenfield steam-turbine factory at Maneja, Vadodara, in the Gujarat province. This new factory, with an investment of about 50 million euros, also included enhancing the existing manufacturing capabilities at Vadodara.

The factory commenced operations in January 2007, and today has a workforce of around 200 employees working on a number of industrial steam turbine models of up to 50 megawatt (MW) capacity. Spread over an area of 60,000 m², the new facility has two manufacturing halls that house a turbine assembly bay and a condenser bay, respectively. The factory is presently producing around 70 turbines per year, predominantly for the sugar, metal-processing and pulp-and-paper industries. The new facility also provides after-sales and repair services.

And there is room for expansion too. If the market grows as expected, by 2010 Siemens will double the output with commensurate increase in headcount.

Serving Indian industry
India is a booming market and Siemens is all geared up to be a part of the great Indian growth story. The recently constituted Siemens Turbomachinery Equipment business, formed by the integration of KK&K into the Siemens group, is also a part of the group’s ambitious growth strategy. Having absorbed the low-range market share — previously the province of KK&K — the turbomachinery business has gained even more prominence as it now covers the entire range of industrial steam turbines. In addition, the new factory at Vadodara, with enhanced manufacturing capacity and service workshop facilities, is also well poised to serve existing and new customers in the local and international markets.

Bags of bagasse to sweeten the bottom line of the business
Among the typical customers of Siemens’ steam-turbine business in India, sugar mills such as Shree Krishna Khandsari represent a major share. The factory is located in Taloda in the Nandurbar district of Maharashtra and was supplied a SST-050 by Siemens in September 2005. Beginning with a production capacity of 200 tons per day (tpd) in 1973, the Shree Krishna Khandsari sugar mill has since then grown to the present capacity of 1100 tpd. Thriving on quality and supported by a committed workforce of 300 employees, it has successfully endured the competition posed by other sugar mills located in the vicinity.
The factory produces Khandsari sugar with molasses as a by-product for use in other applications. The sugar cane is procured from suppliers nearby in Maharashtra, and as the demand for the sugar product is high, the factory has excellent future prospects. Currently catering only to the domestic market, the factory is already planning for a distillery in the near future.

The SST-050 turbine supplied from Vadodara was originally from the stable of KK&K and sold by Siemens under license. Having an output of up to 2 MW, this model of turbine was considerably smaller than the established range of Siemens’ industrial turbines. But its importance for the Indian market, and the type of industry which the Shree Krishna Mills represents, was and is undeniable. Siemens was glad to add this turbine to its range. Now, of course, Siemens has access to a complete spectrum of STE turbines that range from 45 kilowatts to 10 megawatts, and thus has a broader variety to adapt to its customers’ needs.

The turbine supplied to Shree Krishna Khandsari is used for captive consumption while the steam generated is used for the sugar process. The turbine is normally used for a period of five months, mainly between November and March, when the sugar crop is available. Apart from the cane crusher and sugar manufacturing unit, the steam turbo-generator set is the main equipment at the mill.

The steam, having an exhaust back pressure of 1.5 kg/cm²(g), is used for the sugar manufacturing process. The remaining power from the turbo-generator set is used for the house load of the plant.

Increased reliability, improved economy

The new turbine was part of a refurbishment to help the customer cope with the increasing power requirements of the plant. The new turbo-generator set has improved the reliability of the complete sugar plant, and in turn has enabled the mill to be totally independent from the state grid (MSEB, Maharashtra State Electricity Board), which is plagued by constant frequency fluctuations as well as power shortage.

In-house bagasse is used as fuel, which allows power to be generated at a very economical price compared to the charges paid to the electricity board. The promoters of Shree Krishna Khandsari, Mr. Girish Agarwal and his brother Mr. Satish Agrawal, calculate that they are now saving 1.8 million Indian rupees (MINR) per month due to the turbogenerator set installed for captive power generation. The cost of power from the electricity board was 2.6 MINR per month, whereas the cost for the same amount of power generated by the turbogenerator is 0.8 MINR, thus making a clear saving of 1.8 MINR per month.

The Agarwal brothers have planned well for their company’s economy. Reliable and economical electricity supply is a sure basis for future development along the route that they have mapped out for their growth. A small company maybe, but with a big future!
Khandsari sugar

India is the world’s major producer of cane sugar, and its sugar industry continues to grow. Annual centrifugal production has reached 16 million metric tonnes raw value (mtrv), which includes nearly 1 million tonnes of khandsari sugar. India is also the world’s major producer of non-centrifugal sugar, accounting for perhaps as much as two-thirds of the total. Practically all of this sugar is consumed in India; only rarely, after exceptionally good harvests, are small quantities exported.

Khandsari has fewer calories than sugar. It is a natural sweetener and is free of sulfur and chemicals. It is one of the significant agricultural products of small-scale industry in India. Originally confined to the State of Uttar-Pradesh, small-scale Khandsari sugar production is now country-wide.

Khandsari sugar is also known as "Cottage Sugar". It is obtained in unrefined crystalline form from small-scale sugar industries known as Khandsari units. There are about 7,500 such units in the country. Around 45 to 50 percent of the total sugar cane produced in the country is absorbed by the Khandsari industry, which provides employment to about 2.5 million people.
You’re never too small for a big future.

In November 2006, Siemens acquired the business of Kuehnle, Kopp & Kausch (KK&K). Main products are steam turbines as well as compressors and fans for industrial applications. In June 2007 the company was renamed Siemens Turbomachinery Equipment (STE). VENTURE met with Werner Stoebener, head of steam-turbine engineering.

Q: “No one’s too small for a big future.” Is this how the predesigned steam-turbine business perceives becoming part of Siemens?
A: We have traditionally been a small player rather than a “global” one, but as part of Siemens we will indeed be part of a global network, with full integration into Siemens.

Q: Why did Siemens take over KK&K, and what’s in it for you?
A: KK&K was up for sale, and Siemens were interested in our business and markets, which were complementary to theirs. As for us, we get a lot of additional requests and contracts via the Siemens global sales network. Plus, we get requests from parts of the world where we had no coverage in the past, for instance from the Americas and parts of Asia. In parenthesis I should like to say that becoming a part of Siemens has been welcomed by our workforce.

But there is another positive aspect: in the past, we were owned by financial institutions with only limited interest in our core business. We greatly appreciate being a strategic part of a concern and benefitting from synergies in technology. We believe the current constellation to be a far-reaching guarantee for the persistence of our business activities.

Q: What is KK&K’s importance for Siemens?
A: Yes, that’s correct. The SST-050, which is the Siemens designation, is a turbine from the KK&K portfolio. A manufacturing licence for this turbine was issued to ABB in India at the end of the 1980’s. As a result of corporate development, the licence was taken over by Siemens some five years ago, and the SST-050 became part of the Siemens steam turbine portfolio, marketed in India through Siemens’ Vadodara operations. The SST-050 turbines are relatively simple, robust machines which are particularly suited for such applications as sugar mills, including mechanical drive of shredders or power generation.

Q: What is the sales volume of these machines in India?
A: About 20 to 25 turbines per year, the main share going to the sugar mills or comparable industries. Before becoming part of Siemens, KK&K steam turbines for the Indian market were marketed from Frankenthal or via local agents. But it will be a lot easier, of course, having a local affiliate and local manufacturing facilities. In future the Vadodara facility will build the SST-050 together with a range of other machines in the Indian market. We expect to expand our market share considerably through this local presence. India is a booming market, and we want to be part of the boom!

Q: Were KK&K and Siemens competitors on the Indian market in the past?
A: Not really. Siemens’ presence in the Indian market was on an entirely different scale compared to ours. We marketed different machines for different applications. Whereas we marketed steam turbines for smaller
industrial applications, Siemens marketed larger turbines for power utilities or larger process facilities.

Q: So the product lines dovetail neatly in a single portfolio?
A: KK&K had a very good market position in its class of turbines and compressors, just as Siemens was very successful in marketing the higher power ratings. Our portfolios matched perfectly without overlapping, and could be merged without product redundancies and without market delays. It means that Siemens now has an integrated offering for a full range of steam turbines with any required power rating, including the low-scale range where they did not previously operate.

Q: The compressors you mentioned are turbocompressors, is that right?
A: Correct, KK&K has exclusively manufactured turbo-machines, including exhaust-gas turbochargers for the automotive industry until a couple of years ago. Today, we manufacture steam turbines up to 10 MW, and ventilators for power plant and water processing applications. Our turbocompressors are mainly employed in process plants and water treatment plants.

Q: How about the unique selling proposition of the former KK&K turbines? What sets them apart from competition?
A: The vast majority of our sales are single-stage steam turbines with integrated gearbox. A somewhat unique technology to mention is our twin turbine, i.e. two turbines working with a single gearbox, the turbines being able to work at different speeds. This enabled us to build a dual-pressure turbine similar to a 2-stage turbine, which has been well accepted by the market. While these twin turbines offer all the possibilities of multi-stage turbines, they have the extra benefit of small single-stage turbines, including start-up without complicated procedures. But they also have the advantage of a better efficiency than conventional single-stage turbines. This is the development that has had the most positive resonance in the market.

Q: Any additional projects and goals for the years to come?
A: The continuous improvement of efficiencies is a major focus. In addition, we want to further develop our machines to match market-specific standards and specifications, including the oil and gas market, where we do not yet have a significant presence. Moreover, we would like to expand our production-in-market.

Q: Put in a nutshell: what's in for the customer?
A: First and foremost: customer proximity. It is essential for our business, as is local content in a number of countries. As part of Siemens our products will be available virtually everywhere in the world. Additionally Siemens' worldwide service network ensures a service point is within reach on a global scale.
A large proportion of our global reserves of natural gas are described as ‘stranded’, either located at considerable distances from world markets and centers of demand, or without the necessary access to a pipeline. Modern high-volume gas-liquefaction technology reduces the temperature of clean, dry, natural gas to its dewpoint of approximately minus 161ºC (-256ºF), producing a super-cooled cryogenic liquid with a volume about 600 times less than the original gas. As almost-pure methane, liquefied natural gas — LNG — can be transported economically by bulk sea-going refrigerated tankers over far greater distances than high-cost pipelines. The liquid can then be off-loaded, stored, regasified as required and fed into national grids to meet the continuously spiralling demand for this vital source of primary fuel.

BOG compression — A super-cool success story

As the demand for natural gas in its super-cooled liquid form continues to increase on a global scale, ‘BOG’ — or Boil-Off Gas — compressors have become a key part of the LNG supply chain, from production and transportation to storage and regasification. With over 30 years of experience in this technically demanding, highly specialized and fiercely competitive field, Siemens’ market-leading single-shaft turbocompressors represent a continuing success story.

A large proportion of our global reserves of natural gas are described as ‘stranded’, either located at considerable distances from world markets and centers of demand, or without the necessary access to a pipeline. Modern high-volume gas-liquefaction technology reduces the temperature of clean, dry, natural gas to its dewpoint of approximately minus 161ºC (-256ºF), producing a super-cooled cryogenic liquid with a volume about 600 times less than the original gas. As almost-pure methane, liquefied natural gas — LNG — can be transported economically by bulk sea-going refrigerated tankers over far greater distances than high-cost pipelines. The liquid can then be off-loaded, stored, regasified as required and fed into national grids to meet the continuously spiralling demand for this vital source of primary fuel.

BOG — a burning issue

Throughout the entire LNG supply chain, the cryogenic liquid is held in special multi-walled tanks and containment systems, designed to hold bulk supplies of LNG in its liquid state for extended periods. Nonetheless, even the heaviest insulation cannot entirely prevent heat from ‘leaking’ into the liquefied natural gas, raising the temperature just enough to cause gentle but continuous evaporation. Although very few degrees ‘warmer’ than the surface of the liquid, the methane-rich ‘boil-off gas’ (BOG) is still at a temperature low enough to make ice harder than steel. Relatively small amounts of boil-off gas are produced during storage or shipping, but volumes increase dramatically when LNG is exported from the production site (pumped onto the LNG carriers) and during the unloading phase at the receiving terminal. Venting the almost-pure methane presents significant problems, as it is not only a powerful greenhouse gas, but becomes explosively combustible when released into the atmosphere. Controlled flaring can certainly provide an effective means, but simply burning off the BOG is not only a waste of an extremely valuable and increasingly finite resource, but is environmentally harmful.

Meeting demand

First-generation electric-motor driven single-shaft turbocompressors used for boil-off gas compression instead of conventional reciprocating machines, were designed to supply gas at a maximum pressure of some 6 bar used as fuel for boilers producing steam to power the turbine-driven refrigeration trains. Although operating at cryogenic inlet temperatures, the rugged design of these original machines provided exceptional performance and unprecedented reliability, with a number of units first installed during the early 1970s still in regular service. However, in order to meet the continuous increase in demand for LNG, operators were forced to ramp up their production and storage capacities. Steam-turbine driven liquefaction compressor trains were replaced by higher-power industrial gas-turbine powered units, also fueled by boil-off gas but supplied at far higher volumes and at pressures of around 27 bar.

Doubling up

In addition to the significantly greater volumes of BOG generated at the production site, the more-than-fourfold increase in fuel pressure demanded by the gas turbines required a new approach. From single-casing, multi-stage, single-shaft centrifugal turbocompressors designed to supply fuel for steam boilers at about 6 bar, Siemens developed the concept of a two-casing compressor train to provide the necessary volumes and pressures. Using a fixed-speed electric-drive system, two single-shaft turbocompressors are coupled in tandem, the output of a low-pressure machine being fed directly to the input of a second unit, providing the above-mentioned discharge pressure for the gas turbine combustion system.

Quantum leap

Despite providing a cost-effective, high-efficiency and high-reliability alternative to traditional...
Siemens’ groundbreaking IGV technology is also considered for use in increasing the process flexibility of LNG refrigeration trains, offering a significant operating advantage.

Sven Erik Brink, BOG market specialist, Siemens

reciprocating compressors which continue to dominate the market, by 1991 continuous development of turbocompressor systems, materials and components had resulted in a significant breakthrough in the implementation of dry gas seals for shaft sealing at cryogenic temperatures, representing a quantum leap in technology. Heated oil diverted from the standard lube oil supply system is circulated around each seal carrier assembly, providing isolation from the very low temperatures on the compressor suction side as well as from high temperatures at compressor discharge. Even more important, the heated carriers also reduce the effects of thermal shock during start-up, when the seal assemblies at ambient temperature are instantly subjected to cryogenic boil-off gas temperatures.

First record-breaker
The very first single-casing machine to incorporate the new heated dry gas seal technology designed, developed and built by Siemens in Duisburg, entered full commercial operation in 1991 at a major LNG plant in Indonesia operated by PT Badak NGL. The machine has been working trouble-free since installation and has now completed a total of 130,500 fault-free operating hours with zero downtime and no need for maintenance. This feat of faultless endurance, under conditions which would demand the highest and most frequent levels of routine maintenance and significant downtime for even the most rugged equivalent reciprocating machine, was a record-breaking achievement, described simply by proposal manager and BOG market specialist Sven Erik Brink as “the first real step in our success story”.

Control breakthrough
Just two years after the introduction by Siemens of single-shaft turbocompressors incorporating heated dry gas seals, the company marked a further milestone in compressor technology with the introduction of a totally new concept in compressor performance control. The new adjustable Inlet Guide Vane (IGV) system comprises a series of fully-adjustable annular aerofoils fitted around the drive shaft ahead of the first-stage impeller, designed to operate in a similar way to the flaps on an aircraft’s wing. A variable swirl or vortex is created in the gas stream, varying the direction of the inlet gas stream with respect to the impeller flow angle.

Looking to the future
The world market leader for single-shaft BOG turbocompressors with 90 individual machines supplied to LNG production plants and receiving terminals worldwide, and a significant growth in orders for new machines, Siemens has pioneered the use in applications previously dominated by complex and costly reciprocating compressors. However, increasing demand for imported natural gas in the form of LNG has seen a massive rise in production as well as tanker and bunkering capacities. The consequent increase in the volume of BOG generated during loading and unloading of LNG is now approaching the technical limit for reciprocating compressors, making single-shaft turbocompressors the ideal choice. Sven Erik Brink points out that, in addition to covering all BOG applications in even the largest planned installations, a brand-new market has the potential to continue the success-story for future Duisburg-designed machines. “The latest application is for something called ‘jetty recovery’, where boil-off gas produced by pipeline heat leakage during bulk tanker loading at already existing LNG plants is recovered instead of being flared off,” he explained. The concept under development would use a single-casing, single-shaft turbocompressor to compress the gas to around 8 bar and return it to the process plant or for further boosting up to gas pipeline pressure, an elegant solution designed to save money and the environment. These compressors would need to run intermittently (start-stop) and, for that, the unique Siemens design, featuring IGV for easy compressor start and heated seal carriers for protecting the seals from thermal shock, is the most reliable concept for such demanding and harsh operating conditions. Sven Erik also indicated that Siemens’ groundbreaking IGV technology was being considered for use in increasing the process flexibility of LNG refrigeration trains, offering a significant operating advantage to another of the company’s product ranges.

As the pace of compressor development continues to match the demands of customers throughout the LNG supply-chain, it is giving a whole new meaning to the description of ‘bog-standard’, as the epitome of gold-standard engineering excellence.
Dateline

20–23 November 2007
Oil, Gas, Chemistry 2007, Perm, Russia

22–25 November 2007
Innova Energy, Brussels, Belgium
http://www.innova-energy.com/Common/Programme.aspx

05–07 December 2007
Vietnam Electricity Expo, Hanoi, Vietnam
http://www.vfabric.com/electric/

11–13 December 2007
POWER-GEN International, New Orleans, USA
http://pgi07.events.pennnet.com/fl//index.cfm

14–16 January 2008
Petrotech, Manama, Bahrain
http://www.mepetrotech.com/

29–31 January 2008
Offshore West Africa, Abuja, Nigeria
http://owa08.events.pennnet.com/fl//index.cfm

04–06 February 2008
POWER-GEN Middle East, Manama, Bahrain
http://pgme08.events.pennnet.com/fl/index.cfm

14–17 February 2008
Oceantex 2008, Mumbai, India
http://www.chemtech-online.com/oceantex/