VENTURE

INTO THE WORLD OF INDUSTRIAL ROTATING EQUIPMENT

No 2_June 2005

Power Generation SIEMENS

FOCUS
LIQUID ASSETS

MONITOR
TURNING UP LATVIAN POWER

LEADING EDGE
SMART ATTRACTION

Dear Reader,

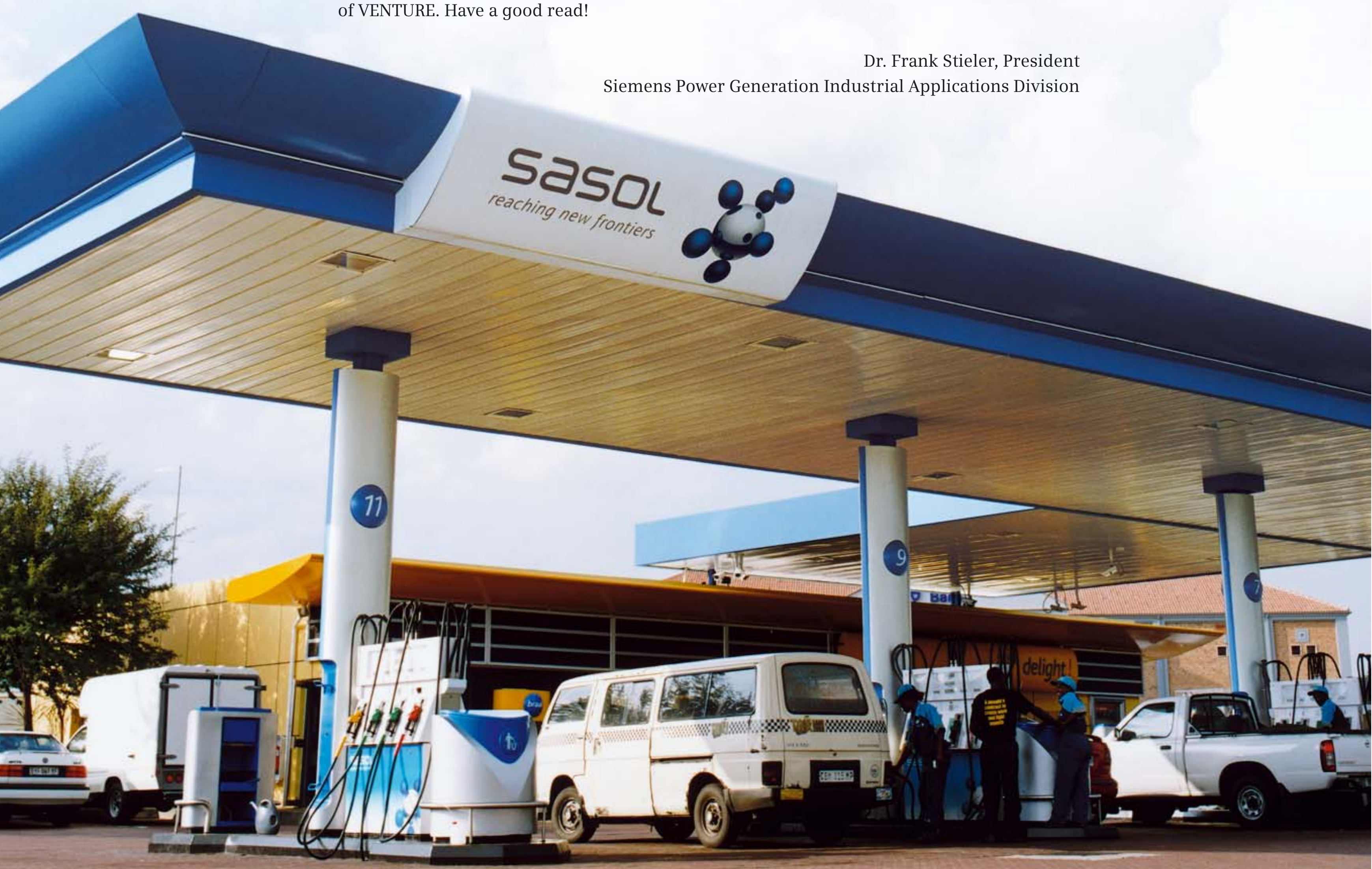
Global trends in energy demand and supply call for constant improvement of technologies in a range of industries. At the same time, processes considered uneconomic when crude oil prices were low are in the focus of interest today.

In this issue of VENTURE we will visit Sasol's facility in Secunda, South Africa. Here, a Siemens-built compressor with a capacity of more than 700,000 cubic meters per hour proves that a vital part of front-end technology for large-scale GTL and CTL plants is indeed available. It enables the economies of scale necessary for a commercial production of fuels and petrochemical intermediates from natural gas or coal.

At our Hengelo facility we explore the benefits of Active Magnetic Bearings, enabling smarter compressor solutions for a range of applications challenging in terms of technology and environmental protection as well as total cost of ownership. And in Riga, the lively capital of the Baltic Republic of Latvia, we take a look at a brand-new combined-cycle cogeneration plant designed to meet the country's rising power demand and the requirements of the EU Clean Air Directive.

A working relationship with our customers, based on trust and commitment, and an uncompromising drive for optimal solutions are indispensable pre-requisites for success. They are the common denominators, too, at the heart of all projects covered in this issue of VENTURE. Have a good read!

Dr. Frank Stieler, President
Siemens Power Generation Industrial Applications Division



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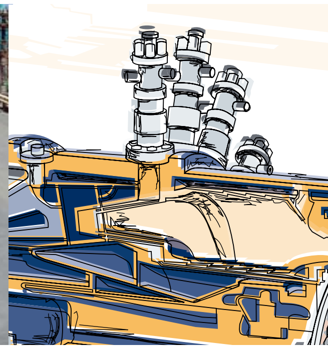
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*1 Declared UNESCO World Heritage in 1991—the old town of Rauma, Finland.

*2 Boasting a full 166 MW—the world's largest offshore wind farm to date, located off Nysted, Denmark.

*3 A total of nine SGT-600 will be running at the Yamama Cement factory from mid-2006 on, the largest number of turbines Siemens has supplied to a single facility.

Around the world

*1 FINLAND—SERVING PULP AND PAPER

In January 2005 Siemens was contracted to deliver a 80 megawatt (MW) back pressure SST-PAC 800 (steam turbine and generator) to the Rauma paper mill in Finland. Connected to a biomass boiler, the turbine will provide power for the factory, process steam for the mill, as well as district heating for the neighborhood, in an efficient and environmentally friendly combined heat and power (CHP) process.

In 1991 the Old Town of Rauma was declared a UNESCO World Heritage site as "an outstanding example of a living and well preserved historical Nordic wooden town." The Rauma of today is both a cultural heritage and a modern industrial town and harbor situated on the gulf of Botnia. It is also one of the world's leading centers for the pulp and paper industries, and home to the Rauma mill, owned by Rauman Voima Oy (60% PVO and 40% UPM). Pulp and paper is among the dominant applications for Siemens industrial turbines.

*2 WIND—FIRST MOVES IN A PROMISING MARKET

In view of the growing international wind energy system business Siemens' Power Generation group expanded its portfolio by the acquisition of Bonus Energy A/S, one of the five major suppliers of wind energy systems worldwide, in December last year. The new Wind Power Division was able to start operations after approval of the acquisition by the EU commission on 1st December 2004.

Within only a month the new division was awarded its first substantial order to supply 40 wind turbines to the Farr Wind Farm in Scotland. It is a turnkey project with a total capacity of 92 MW, for npower renewables, a subsidiary of RWE npower plc.

The Wind Power Division has its headquarters and main assembly plant in Brande, Denmark, and a newly built rotor blade production facility in Aalborg, Denmark. It has installed more than 5,400 turbines with an overall capacity of nearly 4 gigawatts (GW) in more than twenty countries. Having supplied almost half of the world's installed offshore capacity, it enjoys a leading position in this rapidly growing market. In 1991, the company were the first to supply an offshore wind farm, and in 2003 delivered the world's largest offshore wind farm to date with a capacity of 166 MW, located off Nysted, Denmark.

Wind energy will be an important part of the power generation mix Siemens will offer its customers in order to meet the world's increasing power demand in a reliable, cost-effective, environmentally compatible manner. The world market for wind energy systems is currently growing at an annual rate of more than 10%. The new Wind Power Division aims to grow at an even higher rate.

*3 RIYADH—CEMENTING THE CUSTOMER RELATIONSHIP

Yamama Saudi Cement, one of the largest cement manufacturers in Saudi Arabia, decided to add four more gas turbines to the five already installed in order to beef up power generation capacity. The move was triggered by a decision to build a new cement furnace, which would increase production capacity, but also electricity requirement. The new gas turbine power plant replaces an old diesel-driven plant.

When the Yamama Cement factory was initially established, there was no grid to provide the required electricity. A 50 Hz diesel-driven power station had to be built instead. Over the years this station became obsolete and needed replacing. Although the electricity grid is now widespread, the factory could not be connected to it due to Saudi Arabia's 60 Hz standard. Since Yamama Saudi Cement now has access to less expensive gas fuel, the decision was made to build a new plant with gas turbines at the core.

The result was a first order to Siemens in 2003 for a plant based on five dual-fuel 25 MW SGT-600 gas turbines (see also page 11) ready for handover in May. End of last year, four more were ordered, due on site in the spring/summer of 2006. Customer training is taking place in parallel with the installation, enabling the customer's own operation staff to take over the running of the plant seamlessly. Moreover, Siemens have a resident engineer at site for the first year to oversee the commissioning of the first turbines and the installation of the second consignment.

Liquid Assets

The combination of rising costs and limited global reserves of oil have forced a growing number of countries to look with increasing urgency at developing alternative sources of primary energy. Reserves of natural gas remain relatively abundant.

Almost half of the world's natural gas reserves are classified 'stranded gas', i.e. market access is considered uneconomical for whatever reasons. Using large-scale GTL (Gas-to-Liquids) technology, a big share of stranded gas could be converted into a range of clean fuels and intermediate petrochemicals. Technical feasibility and economies of scale required from commercially viable GTL front-end technology are proven at Sasol's Secunda facility near Johannesburg, South Africa. Here, a compressor train with a capacity of more than 700,000 cubic meters per hour —manufactured by Siemens—provides air for a gigantic air-separation plant to produce large quantities of oxygen, an essential ingredient in the front end of a GTL plant. Whilst the said Siemens compressor is installed in a CTL (Coal-to-Liquids) plant, the air separation technology of both processes is identical.

Photos: Florian Sander

The control room supervising all operating parameters of the compressor

BLACK DIAMONDS

For countries with abundant supplies of natural gas, Gas-to-Liquids (GTL) technology is being adopted increasingly as a cost-effective means of creating ultra-clean fuels and oil-based products. The same process is particularly being used to convert remote reserves of natural gas (stranded gas) or gas which would otherwise be flared, into valuable 'synfuels'. Using the same basic process, but with coal rather than gas as the primary feedstock, even low-grade 'black diamonds' can be gasified and converted into a range of clean, high-grade, high-value products including petrol and diesel, providing an efficient means to ensure fuel security. Although converting either natural gas or coal into liquid products is still slightly more expensive than traditional processes, the continuing high price of oil ensures that synthetic fuels and intermediate petrochemicals remain commercially competitive. The major prerequisite, however, is "economy of scale", the availability of reliable large-scale process technology.

GERMAN TECHNOLOGY

Discovered and patented in 1925 at the Kaiser Wilhelm Coal Research Institute in Mulheim by Franz Fischer and Hans Tropsch, the Fischer-Tropsch (F-T) process for converting coal or natural gas into petroleum products represents one of the great technical advances of the 20th century. The basic feedstocks are first converted into synthesis gas—a mixture of hydrogen and carbon monoxide—by partial oxidation, either passing steam and oxygen over heated coke, or by mixing steam and natural gas at high temperatures. In the second step of the F-T process the syngas is reacted with an iron or cobalt catalyst in either a circulating fluidized bed (CFB) reactor or bubbled through a slurry of liquid wax and powdered catalyst, converting syngas into a broad range of hydrocarbons which are subsequently worked up to naphtha, fuels and/or high-grade lube bases.

THE SOUTH AFRICAN CONNECTION

The first commercial coal-to-liquids (CTL) plant using the F-T process was established in the Ruhr valley in the 1930s, but the rights to F-T technology were acquired subsequently by the South African Coal Oil and Gas Corporation, a state-owned organization established by the South African government in 1950. With small reserves of oil but with the seventh largest reserves of recoverable coal in the world, South Africa is the sixth largest producer, currently extracting some 250 million tonnes per year. During the 1950s, the government backed the large-scale development of CTL technology, principally to protect its balance of payments against increasing crude oil imports. In 1955, the company—re-named Sasol—established its first synthetic automotive fuels production plant. Headquartered in South Africa and privatized in 1979, Sasol has grown to become one of the top five publicly listed companies in the Republic. The 7.7 billion Euro organization has some 30,600 employees, operates in 23 countries and is described as an integrated oil and gas company with substantial chemical interests worldwide.

SUPER SECUNDA

The Sasol group's synthetic fuels business is based at Secunda, some 120 km east of Johannesburg. In 1993 its synfuels and petrochemical production facilities were integrated into a single giant production unit and developed to achieve far greater economies of scale. More than ten years on, the development of this massive complex remains the world's largest engineering project ever undertaken at one time, representing a 20-fold scale-up of the original facilities. Today, some 45 million tonnes of low-grade coal from Sasol's five vast underground mines at Secunda — the world's largest underground mining complex — together with the output from two large strip-mining operations, is supplied each year to the adjacent CTL production plant. After initial treatment, a proportion of the raw coal is used directly as fuel for each of four 60-megawatt (MW) thermal power generating stations on the site which provide bulk electricity for the energy-hungry conversion processes.

THE CTL PROCESS

From the coal handling plant, the bulk of the washed and graded coal is fed at around 120,000 tonnes per day to the gasification plant where it is converted into crude syngas under high temperature using superheated steam and oxygen in pressurized reactor vessels. The high-purity oxygen is supplied by 15 air separation plants at the astounding rate of 38,550 tonnes of gas per day, equaling the total air separation capacity installed in the U.K. and making Sasol the world's largest single producer and consumer of oxygen. Following the removal of condensates, sulfur and other impurities, the syngas is reacted under pressure and moderate temperature with an iron-based catalyst in a unique one-step process to produce literally hundreds of high-value chemicals — ranging from Acetic acid to Xylenol — simultaneously with synthetic petroleum products at the rate of some 150,000 barrels per day. The major share of the stream is routed to conventional refinery plants to produce liquid petroleum gas (LPG), propane, butane, fuel oil, paraffin, petrol and sulfur-free diesel.

COMPRESSORS, THE VITAL LINK

Forming the vital heart of almost every stage in the entire CTL conversion process, high power compressor-trains not only provide the necessary gas pressures and flows throughout the reaction from gasification to liquefaction, but are also the single most important component for the production of oxygen in the air separation plants. Through its Demag roots, Siemens has manufactured and supplied compressors to Sasol since the company was founded. Currently there are more than 40 trains in operation at the Secunda site, including the latest and largest Type STC-SR Axial-Radial compressor ever manufactured by the company. The giant 160-tonne machine, which has a capacity of more than 700,000 cubic meters of air per hour, has been installed in the new air separation plant engineered and constructed by Air Liquide. Added to the 14 existing oxygen production units at Secunda, the huge new plant is generating 3,550 tonnes of oxygen per day and is designed to provide up to 10 hours of back-up production in the event that any of the other units, which individually produce 2,500 tonnes per day, are shut down.

Filtered medium-pressure air from the very high volume STC-SR main air compressor is passed through a further Siemens 4-stage radial booster compressor train before contaminants including carbon dioxide and water vapor are removed. In the basic cryogenic separation process, the compressed air is expanded and progressively cooled to around minus 185 degrees Centigrade and distilled to produce process oxygen, together with nitrogen and two rare

noble gases, krypton and argon, which are supplied to Air Liquide as saleable by-products. The temperature of the liquefied oxygen is raised by heat exchange with incoming high temperature air, returning it to its gaseous state before being fed under pressure to the gasifiers.

POWERFUL PROCESS

Although the two essential ingredients of the oxygen production process are simply air and electrical energy, the combined electrical load of the two Siemens compressor trains is a massive 86 MW, enough to supply a city of almost a million people. As a consequence of the enormous power requirement of the Secunda facility, Sasol not only generates its own electricity from on-site power-stations, but also imports additional energy from the South African grid.

CHINA DEAL

The Secunda CTL plant is currently the biggest in the world. However, Sasol and the People's Republic of China recently engaged in a joint feasibility study for further large-scale projects. The objective is to determine the viability of possible CTL projects at two sites in China's coal-rich western region. Plant capacity would be between 70,000 and 80,000 barrels per day at each site. The study is expected to be completed by the end of 2005.

GOING FOR GAS

One of the major advantages of the third-generation F-T conversion process developed by Sasol is its flexibility, being equally able to handle syngas produced from coal or from methane-rich natural gas, to produce synthetic fuels, specialty streams and petrochemicals. In 2004, in a joint venture with the government of Mozambique, the company began importing gas from Mozambique's Temane and Pande gas fields by pipeline to its Secunda and Sasolburg facilities. The gas is not only being used as a supplementary feedstock to coal-derived syngas at Secunda and as a replacement for coal at the Sasol One site at Sasolburg to boost gas-to-liquids production. It is also being supplied direct to customers in both South Africa and Mozambique. In a further joint venture with US oil-giant Chevron Texaco, Sasol is developing major GTL projects in Nigeria and Qatar and is looking to develop a large-scale GTL project in Australia. The 'two-train' plant in Qatar will produce 34,000 barrels of fuel per day. The company is also evaluating opportunities in the Caribbean, Venezuela and other regions and expects to invest about US$10 billion in gas-to-liquids production facilities around the world over the next 10 years.

MEETING THE CHALLENGE

Large-scale GTL technology is growing rapidly on a global basis as an ideal system for converting remote or 'stranded' reserves of natural gas at the wellhead into clean, sulfur-free liquid fuels. With high-power, high-volume compressor trains at the heart of the conversion process, Siemens is not only a prime supplier to many current gas-to-liquids projects around the world, but is already capable of meeting the challenge of providing new machines for next-generation GTL plants as well as Sasol's unique coal-to-liquids systems, in this fast-expanding industry.

Endurance

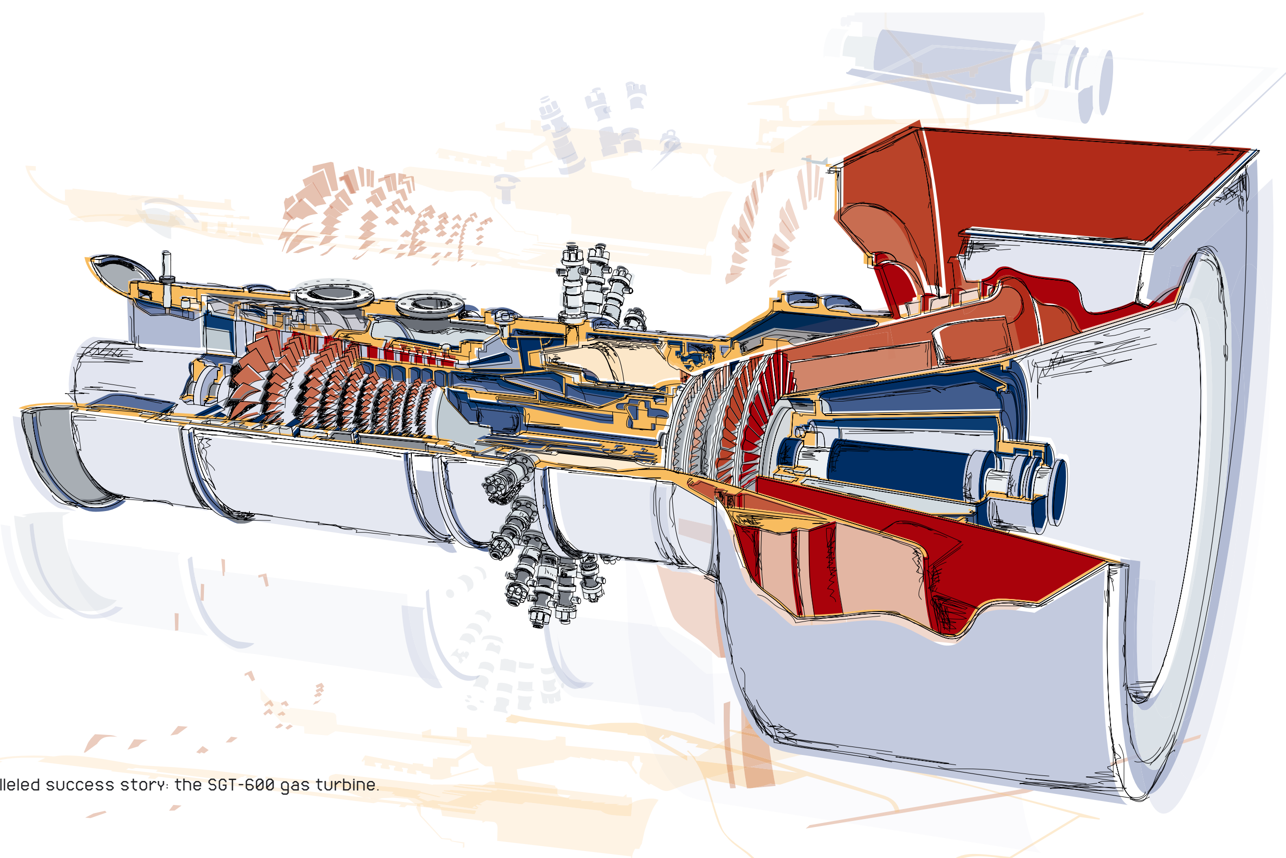
Siemens' SGT-600 gas turbine clocks up 3 million operating hours

By the end of 2004, the worldwide installed population of Siemens' SGT-600 gas turbine (formerly GT10) had clocked up as many as three million operating hours—the equivalent of 340 years of operation. Since some ninety SGT-600s were in operation at the time, an individual certificate of achievement cannot be awarded. But what is impressive is that the fleet leader, which is one of two turbines sited on the outskirts of Athens at the Hellenic Petroleum Refinery in Aspropyrogos, has now accumulated 110,000 hours of excellent operation. The Hellenic Petroleum Group is the largest industrial and commercial group in Greece, with activities covering the whole spectrum of the oil and gas energy market. Aspropyragos is one of four refineries in an integrated operational system.

By the end of this year the turbine will have run 120,000 hours, the maximum number of hours recommended. As a consequence, a team was commissioned by Hellenic Petroleum to investigate alternatives to prolong the life of the plant. The recommended solution in terms of efficiency and economy is to replace one turbine in its entirety, using the parts of the original turbine as spares to revamp the second turbine.

Ordered in 1988, the turbine is one of the original 22-megawatt (MW) models based on the Sulzer design, which was taken over in that year. The design has been modified during the intervening years, the turbine having an output of 25 MW since its uprating in 1991. In 1990 the first SGT-600 with Dry Low Emission (DLE) burners was sold, and has since then become standard, being an integral part of some 154 of the 180 units sold and 75% of the accumulated operating time. The SGT-600 has continued to prove its reliability in both power generation and mechanical drive applications, some 77 units having passed the 8000-hour limit, which is a credibility boundary for many insurance companies.

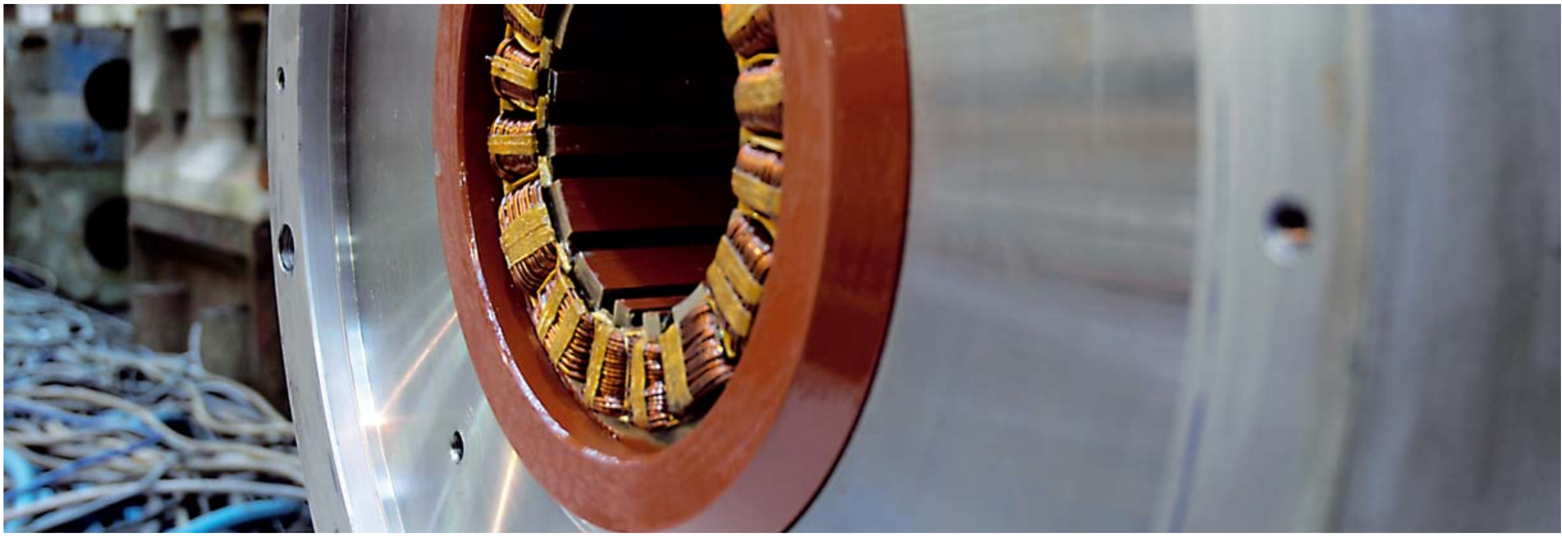
As a result of the upgrade, Hellenic Petroleum will have the benefit of the extra output from the new 25-MW turbine to help them cope with the additional power requirements of their expanding activity. Mr. Stelios Triantafillou, Maintenance Manager of the Refinery, comments: "We have a strong relationship with Siemens, based on the good work done over the last sixteen years but also on the local Siemens presence which facilitates communications."



Unparalleled success story: the SGT-600 gas turbine.

Illustration: Ji-Young Ahn

Smart Attraction



A substantial share of Siemens' current production of compressor trains is fitted with so-called active magnetic bearings (AMB). A glimpse into their concept and performance reveals the appeal of computer-controlled magnetic attraction.

Within a stretch of 400 kilometers, from northern Germany to the northwestern tip of the Netherlands, Siemens is about to deploy a total of 33 state-of-the-art compressor trains. Apart from electrical variable-speed drives, they have one more essential feature in common—active magnetic bearings. While their individual applications vary a great deal, their obvious similarity is the result of comparable requirements in terms of flexibility and total cost of ownership (TCoO).

Setting the scene, Söhlingen, a village some 90 kilometers southwest of Hamburg, Germany, is the location of a 70 billion cubic meter tight-gas reservoir. What makes exploitation so demanding is the Dethlinger sandstone, a substrate with permeability 1,000 times lower than that of conventional reservoirs. Hence the denomination 'tight-gas'. Any compressor solution suitable for exploiting this reservoir must have outstanding flexibility in adjustment of suction pressure in order to match drops in wellhead pressure.

Further to the west, the Groningen natural gas field, in the north of the Netherlands, is used as a peak flow supplier with continuous production swings due to daily and seasonal fluctuations of demand. The field has been depleted by more than 50% since exploitation started in the early sixties. In order to satisfy future contractual delivery requirements, NAM B.V. is about to install 500 megawatts (MW) of compressor performance at a total of 29 clusters. Implications from the applied TCoO calculation model and the functional requirements of an extremely wide operating area again called for a compressor solution providing extreme flexibility.

Another 200 kilometers westward, the continental end of the BBL pipeline from Balgzand, Netherlands, to Bacton, United Kingdom, will soon be fitted with latest Siemens compression technology, including VSDS high-speed motor direct-driving multi-stage compressors both equipped with active magnetic bearings. Designed to pump natural gas to the British Isles through a 230-kilometer sub-sea pipe, the compressor solution will be at the bottleneck of this hitherto missing link between the continental European and the U.K. gas transport infrastructures. Among the key performance requirements is, as always, a flexible response to fluctuations in demand, but also low-maintenance, remote-controlled operation.

Active magnetic bearings are the single most important part common to all of the solutions for the above cases. Indeed, it was the bearing solution which expanded the operating area of compressor trains with electrical variable-speed drive systems to meet the given requirements.

A LEVITATING EXPERIENCE

An AMB solution typically consists of three distinct parts: the bearing itself, the electronic control system, and the auxiliary bearings.

A total of 33 Siemens state-of-the-art compression solutions are currently about to be deployed in an area crisscrossed by gas streams from all over Europe.

Fed by position transducers in the magnetic bearing, the electronic control system sets the current flowing through the respective electromagnets providing optimum stiffness and damping properties. In terms of control theory, controller, transducers, electromagnets and the levitated rotor form a closed control loop.

In practice, active magnetic bearings feature a number of characteristics outperforming conventional oil bearing solutions widely employed in the world of rotating equipment. Due to their contact-free levitation, AMBs require no extra lubrication, thus eliminating a potential cause of pollution and the need for storage and pre-heating installations for thousands of liters of lube oil. Lead and lag times related to oil-heating are no longer an issue, while bearing losses are typically an order of magnitude less than friction losses associated with oil bearings. A magnetically levitated 10-tonne rotor can be turned by hand without too much effort.

Moreover, AMBs keep vibration at a minimum over a wider operating area, a major benefit for all of the cases mentioned above. Being virtually wear-free and needing substantially less maintenance, AMBs provide for increased availability. Due to their electronic control system, machines employing AMBs allow for a higher degree of integration into a comprehensive facility control and management system, including the possibility of remote control from virtually anywhere.

WHAT IF?

Most of this may sound like a blueprint for perfection. So what's the downside, say, if magnetic bearings fail? Some 10 tonnes of steel spinning at over 6,000 revolutions per minute represent a kinetic energy not to be taken lightly. As a consequence, the auxiliary bearing system is a point of special engineering interest. It will catch the rotor in case of an emergency. Typically, the clearance between rotor and auxiliary bearings is 50% of that between rotor and magnetic bearings. Hence, in the unlikely event of uncontroled delevitation, the rotor will not impact on the magnetic bearings. Coated with a dry-film lubricant, the auxiliary bearings will pick up part of the rotor's kinetic energy; the major share, however, will be fed back into the grid as electrical braking energy. Elaborate landing tests have provided a host of experience used to verify and optimize the parameters of a computer model simulating the process and characteristics of uncontrolled delevitation. In a real-life installation, total rotor standstill is expected after a mere 5 to 7 seconds with compressor trains of the type in question.

BUILDING INTELLIGENCE

For a comprehensive understanding and control of the rotor dynamics of a compressor train, all components of the control loop have to be modeled, including among others the actual rotor, controller, sensors, a/d converters, processing circuitry, and amplifiers. The specific transfer characteristics of these components are formulated as so-called transfer functions. Of special importance is the transfer function of the controller. Enabling a precise control of rotor dynamics, it is designed to ensure optimal attenuation of vibrations at critical speeds. In a sense, these speeds are henceforth no longer 'critical', but are part of the standard operating area of the compressor solution, thereby greatly extending its flexibility.

What's more, special controller concepts allow the rotor to rotate along its axis of inertia in order to minimize the force to be executed by the magnetic bearings. As a result, rotor operation is less affected by potential changes of the rotor's balance condition, e.g. due to compressor fouling, translating into a reduction of maintenance requirements and improved machine availability.

SMART SOLUTION

Wide operating area, extended availability, low maintenance, and un-manned remote-controlled operation—these are but a few of many technical challenges affecting a TCoO model one way or another. Active magnetic bearings can greatly contribute to achieve a number of these goals at the same time. For some concepts, they are even an indispensable pre-requisite, opening up fields of applications previously claimed by traditional industry solutions, especially applications where an infra-structure for oil-based bearings and gearbox lubrication does not readily exist. In that respect, it is a safe venture to predict that AMB technology will have a bright future.

Illustration: Lorna Egan

Eriks Priednieks, Project Director, Latvenergo

Working Together, Making it Happen.

Latvenergo, Latvia's state-owned utility, invested into a brand-new state-of-the-art power plant being built by Siemens in the country's capital city Riga (see also page 16). Taking time out from a hectic schedule, Eriks Priednieks, Project Director, was able to give Venture some interesting client-side insights.

Venture: Mr. Priednieks, can you give a little bit of background on the power plants operated right now by your company throughout Latvia?

Priednieks: Yes, of course. There are just five large plants serving the whole of the country, three big hydroelectric units with a total capacity of about 1,500 megawatts and our two combined heat and power plants, this unit here, the 130-megawatt TEC1 and the larger 390-megawatt TEC2.

Venture: But I don't think these can meet all of Latvia's power requirements, can they?

Priednieks: That's right, they can't. The three big hydro stations represent about three-quarters of the country's installed capacity, but as the typical peaking plants they can operate at full capacity only for very limited time periods. This means we have to import electricity, mainly from Estonia and Lithuania. That's giving us another problem, though. Many of their own power plants don't meet EU emissions standards and a number of them have to shut down, so there will be no surplus capacity to export to us.

Venture: Does this mean you will have to build more power plants over here? And are there any plans to replace your other gas and heavy oil-fired thermal CHP station, TEC 2?

Priednieks: Yes, indeed. Like TEC 1, we want to replace TEC 2 with a modern, efficient gas turbine installation that will meet EU clean air standards. Actually, we have just put this project out to tender and I believe that Siemens may well be among the companies putting in their bid for this new project.

Venture: We will obviously have to "watch this space!" But turning back to the present project, as well as cutting emissions, what do you see as the main advantages of a gas turbine-based heat and power plant?

Priednieks: Well, in addition to much higher reliability and availability, the new plant will have much lower operating costs and give a dramatic improvement in the ratio of heat to power. It will be almost one-to-one, compared to our existing thermal CHP units which produce about four times as much heat as electricity.

Venture: Back in 2003, you actually bought the new plant from Alstom, but it is now being built and delivered by Siemens. Has this given Latvenergo any special problems?

Priednieks: There were some practical issues for us when Siemens took over the project, primarily contractual problems, but happily, all of these have now been completely resolved.

Venture: So has Siemens been able to meet your expectations and requirements?

Priednieks: Very much so. You see, we have had the continuity of working with the original Finspong team even as part of Siemens, and all our requirements on the project have been more than fully met. If anything, we have had a far better degree of support than we could have expected, not just in terms of technical engineering skills and experience, but also in project security through Siemens' financial strength.

Photo: Florian Sander

Turning up Latvian Power

Helping to meet today's booming energy demand in the Baltic Republic of Latvia, a Siemens-built combined-cycle cogeneration plant will supply high-efficiency heat and electricity to the distribution networks of the Latvian capital Riga.

It is probably true to say that along with death and taxes, another more recent certainty in life is that of rising prices. With continuing pressure on diminishing resources, it is not surprising that the cost of the most important 'fossil' fuels—principally oil and gas—continues to spiral upwards. While the pump-price of petrol and diesel is a major concern to every motorist, the continual upward trajectory of natural gas prices is probably having an even greater and more far-reaching impact on even larger numbers of people.

The availability over the last several decades of this clean, 'green' source of primary energy as a relatively low-cost and plentiful fuel has led to the widespread use of natural gas, not only in our homes for cooking and heating, but in ever-increasing volumes for the generation of electrical power. Today, diminishing supplies combined with rising prices and the prospect of irreversible climate-change mean that energy-users of all shapes and sizes are being forced to seek greater fuel efficiencies.

TECHNOLOGICAL SOLUTIONS

Nowhere is the push for higher efficiency, lower emissions and reduced operating costs more keenly felt than in the power industry. Spearheaded by the world's leading power engineering innovators including Siemens, latest-technology systems and equipment are being developed continuously to meet the challenging demands of today's new breed of lean 'green' power producers.

With advanced-technology gas turbines at the heart of the vast majority of modern power generating plants, overall efficiencies have been raised progressively while atmospheric emissions levels have been similarly reduced. Operating in 'combined cycle', where exhaust heat from a gas turbine is used to produce steam for a further turbo-generator, efficiency levels are now approaching 60 per cent. If, as well as using the gas turbine to generate electricity, the steam raised from its high temperature exhaust is used directly as a source of heat —for an industrial process or for an urban 'district' heating network for instance—operating efficiencies can soar to higher than 80 per cent. For a given output from this type of combined heat and power (CHP) generating plant, both fuel use and atmospheric emissions are reduced very significantly, the modern 'cogeneration' technology providing an efficient cost-cutting solution for the power utility or industrial operator.

Although combined heat and power production is itself a 'mature' technology in current and widespread use throughout Europe and the industrialized West, post-Kyoto pressures and modern market forces have forced the pace of development. Older, obsolescent thermal CHP generating stations using oil or coal-fired boilers, often unable to meet statutory emissions requirements, can now be replaced by high-efficiency, low environmental-impact, gas turbine-based cogeneration units, helping to save fuel, money, and the planet.

Photos: Florian Sander

TECHNOLOGY AT WORK

Supplying just such a state-of-the-art solution for Latvenergo, the state-owned power utility in Latvia, a new Siemens combined cycle-cogeneration plant is now nearing completion in Riga, the country's capital city and principal seaport. Formerly part of the USSR, the Republic of Latvia regained its independence in 1991 after the break-up of the Soviet Union and is now a full member of the European Union. The country, which has a population of around 2.7 million, more than a quarter of whom live in the capital, has a fast-growing economy and is seeing rapid growth in areas including the construction industry and tourism. However, it has no indigenous reserves of coal, oil or gas and is almost totally reliant on imported fuel to support its burgeoning growth. Latvia's installed generating capacity is also insufficient to meet demand, the shortfall being met by electricity generated in neighboring Baltic States imported through the Baltic Ring power transmission network.

In July 2003 Siemens won a 106 million euro turnkey contract for a new combined heat and power plant designed to replace TEC1, a 1950's Soviet-built thermal cogeneration plant. Still in operation, this obsolescent generating plant has a nominal electrical output of 130 megawatts (MW) and feeds 616 MW of heat into the district-heating network. Constructed originally to burn a combination of locally-produced peat and natural gas imported from Russia, TEC1 is now completely unable to meet even the basic statutory requirements of the EU Clean Air Directive, forcing state-owned energy utility Latvenergo to undertake its shutdown and replacement.

SO FAR—SO GOOD!

Due shortly to enter the commissioning phase, the new 'SCC-800 2x1' power plant will have an electrical output of 140 MW and will supply 150 MW of heat to Riga's district heating system. Designed at Siemens' production center in Sweden, the plant consists of two 45 MW natural gas-fired GTX100 gas turbines (now re-named SGT-800) optimized for combined cycle operation and a single 54 MW extraction steam turbine. Steam is supplied to the turbine and the district heating network by two heat recovery steam generators with supplementary gas firing, together with two additional gas-fired heat-only boilers. Light distillate fuel is used solely for stand-by purposes.

What happens to the energy in the fuel?

For further details on CHP and combined-cycle generation, please visit www.CHPa.org.

Siemens Project Manager Leif Larsson is obviously satisfied with current progress. "So far we have not had any really major problems on this project and, although there are about 500 people of many different nationalities employed on-site, the accident rate has also been phenomenally low," he commented. "All the usual snags we've had during the construction phase have been overcome without too much difficulty and we have been able to keep to the planned schedule."

Operated after handover by Siemens-trained Latvenergo staff, preventative maintenance will be carried out at the new plant by specialist lead personnel from Siemens under a recently-awarded 15-year service contract valued at 30 million euro. "This contract is one of our biggest so far," says Thorbjörn Fors, Regional Service Director. "The running-time is for the full operational life of the gas turbines and includes five major overhauls and intermediate inspections for all three turbines." This will ensure that the plant will supply both heat and electrical power as critical elements within Latvia's burgeoning economy, economically, cleanly, reliably and with maximum availability, over and even beyond its entire operational lifetime, a far cry from burning potentially polluting peat.

Illustration: Lorna Egan Photos: Florian Sander

Dateline

06–09 June 2005	ASME TURBO EXPO, Reno, Nevada, USA, **http://www.asme.org/igti/**
14–15 June 2005	CEE—DELIVERING POWER QUALITY IN THE ENLARGED EU, Budapest, Hungary, **http://www.cee.antfx.com/**
13–16 June 2005	OIL&GAS ASIA (OGA), Kuala Lumpur, Malaysia, **http://www.oilandgas-asia.com/**
21–24 June 2005	PETROLEUM AND GAS CONGRESS (MIOGE), Moscow, Russia, **http://www.mioge.com/pages/home.htm**
28–30 June 2005	LATIN AMERICAN PETROLEUM SHOW (LAPS), Maracaibo, Venezuela, **http://www.oilonline.com/laps/**
28–30 June 2005	POWER-GEN EUROPE, Milan, Italy, **http://pge05.events.pennnet.com/**
10–11 August 2005	CHINA POWER, Beijing, China, **http://chp05.events.pennnet.com/**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