

COMPRESSOR REVIEW

Hydrocarbon Engineering presents a selection of advanced compressor equipment, technology and services that are available in the downstream oil and gas industry.

Ariel Corp.

Ariel Corp. is the world's largest manufacturer of separable, reciprocating gas compressors. Founded in 1966, Ariel compressors are currently operating in all segments of the oil and gas industry. With a product line ranging from 19 kW to 7.5 MW, more than 60 000 Ariel compressors have been shipped to over 100 countries around the world in a wide variety of applications. These include upstream applications such as natural gas gathering, transportation and storage, midstream gas processing operations and a number of critical downstream applications.

Designed to meet the reliability requirements of API 618, Ariel moderate speed process compressors are currently operating in refineries, chemical plants and industrial gas facilities around the world. Available with either lubricated or non-lubricated cylinders, these compressors are



A multi-service hydrogen compressor.

operating in a range of critical process applications. Conservatively designed and applied, Ariel process compressors meet or exceed industry standards for continuous runtime.

Among the design features of Ariel API 618 moderate speed process compressors are:

- Low piston speeds.
- Reduced wear band loading.
- Conservative discharge temperatures.
- Reduced valve impact velocities.
- Hardened cylinder bores.
- Non-cooled cylinders.
- Application specific wear part materials.

The continuous supply of hydrogen is crucial to refinery and petrochemical plant operations. Whether the hydrogen plant is 'inside the fence' or 'over the fence', the proven reliability and world-class customer support of Ariel process compressors will ensure hydrogen is delivered, whenever it is needed. In addition to hydrogen production, other hydrogen applications currently using Ariel process compressors include hydrogen makeup and recycle, feed gas, fuel gas, hydrotreating, hydrodesulfurisation, renewable fuel production, chemical processing, hydrogen storage and transportation. These compressors range in size from 15 to 5000 kW, with discharge pressures up to 400 bar.

Multi-service hydrogen compressors, such as the one pictured, are common in steam methane reformer (SMR) hydrogen production facilities. This photo is from a large hydrogen production facility supplying hydrogen to a refinery in the Midwest USA. In this case, the compressor delivers natural gas feed to the steam methane reformer and at the same time delivers the hydrogen product gas to the refinery.

COMPRESSOR REVIEW

Atlas Copco Gas and Process

Across the globe – from the US, the Middle East and China – Atlas Copco Gas and Process has produced some of the most reliable and available machines for the world's most demanding chemical-petrochemical applications.

The polyolefin process can be particularly complex and rigid, and the company's 50+ years of expertise in this market has enabled the design of turbomachinery that offers 99% availability, even in harsh environments.

Whether its customer's application requires a direct-driven or integrally-geared compressor solution, all of Atlas Copco Gas and Process' machines are engineered to help support plant availability (e.g. by reducing polymerisation risks in the compressor). To that end, critical components such as impellers, casings, guide vanes shaft seals, gears and bearings are anchored in proven, field-tested designs that were specifically engineered to reduce these risks.

In addition to engineering reliable and available turbomachinery, Atlas Copco Gas and Process is always

mindful of the costs that affect customer decisions in each purchase. In many scenarios, standardised machinery can be used to lower CAPEX and shorten delivery times. All machines – standardised and custom – feature unique aerodynamics that match each process. The custom aerodynamics coupled with Atlas Copco's efficient designs allow for OPEX savings once the machines are running.

Atlas Copco Gas and Process can design a robust, reliable polypropylene /polyethylene compressor which meet the standards of API 617, API 614, ERC (Russia), CSA/CRN and others.

In addition, Atlas Copco Gas and Process helps customers prepare for tomorrow by designing, building, and servicing turbocompressors, gas screw compressors and turboexpanders for the oil and gas, power generation and industrial gases industries.

Atlas Copco Gas and Process is a division of the Compressor Technique business area, headquartered in Cologne, Germany, with additional production centres in the US, China and India

Cryostar

Cryostar is a leading supplier of cryogenic equipment for industrial and natural gas applications, including cryogenic pumps, turboexpanders, small scale liquefaction plants, LNG boil-off gas (BOG) compressors and LNG vaporisers.

Cryostar's multistage cryogenic vertical process (VP) pump is designed for continuous operations with all liquefied air gases, dedicated to air separation unit applications. The pump is generally used for internal compression, recycling, send out, back-up (O₂/N₂/Ar) and in methane wash or LNG applications. Kept in permanent cold stand-by, the pump is ready for an immediate start. With various sizes of VP pumps (from 115 to 330 mm) and the modular multi-stage design, the range of flow rates is extended from 25 to 5000 l/min (1350 gpm), up to 130 bar (1900 psig). The VP pumps are equipped with a standard

choice of sealing systems, interchangeable according to the process: two or three chambers labyrinth or dry gas seal. Reliable and safe, the VP pump is supplied with a rigid and insulating flange to mount on the cold box. The pump is submitted to stringent performance tests in cryogenic conditions, in the world's largest liquid nitrogen test facility.

With more than 50+ years' experience in the cryogenic pump business and more than 5500 process pumps installed, Cryostar is a customer-focused organisation, with the support of nine business centres worldwide, and a network of agents and distributors.

Cryostar also offers long-term equipment follow-up, including supervision, on site intervention with skilled technicians, on-site or in-house repair services, spare parts, and revamping.

C.S.T. – Compression Service Technology S.r.l.

C.S.T., founded in Florence, Italy, in 2002, was initially composed of just four people and worked as a service engineering provider for an Italian original equipment manufacturer (OEM), mainly for reciprocating compressors.

In 2004, the company began to set up a remote monitoring and diagnostic service for reciprocating compressors. It started with the design of machine components and packages for reciprocating compressors and later moved onto centrifugal compressors. In the meantime, the company has developed its proprietary software for performance simulation, as well as pressure pulsation, vibration, and rotor-dynamic analyses.

The company recently produced its own line of precision lubrication systems for cylinders and packings of reciprocating

compressors, called CST-PLS. The system, designed on the basis of over 15 years of experience in reciprocating compressors, has been successful since the first application.

In just 15 years, C.S.T. has transformed from a local maintenance engineering provider for reciprocating compressors into an international player for critical machine applications in the oil and gas and other industrial sectors.

The company currently employs around 50 staff, and while its business was initially almost 90% in Italy, in the next year C.S.T. expects to reach 50% of its sales from foreign markets.

The company is composed of four main divisions: machine design, system engineering and construction, service and remote diagnostics, and R&D. C.S.T. is able to offer full-scope customer support, from design to project execution and troubleshooting, remote monitoring and

COMPRESSOR REVIEW

diagnostics, revamping, conversions, upgrades, resource lifecycle management, site service and field supervision.

Its clients come from a wide range of industries including machinery and equipment OEMs, equipment packagers, EPC contractors, end users, and service companies.

The company's success lies in its ability to work on the complete machinery cycle, which allows the continuous transfer of field experience to new designs and, vice versa, the possibility of tackling the problems of the field with design expertise.

Elliott



Elliott compressor installed in a PDH application in China.

Elliott Group designs, manufactures and services centrifugal compressors for downstream applications. From distillation through production, Elliott centrifugal compressors are in critical service around the globe in refinery and petrochemical processes, including transportation and commercial fuels, lubricants, liquefied gases, shale gas, natural gas byproducts, olefins, petrochemical feedstocks, and speciality products such as coke and asphalt.

Elliott® compressors are custom designed and configured for specific process requirements including

cracked gas and refrigeration applications in ethylene and propylene production, multi-flow refrigeration applications in LNG liquefaction, and high volumetric flows in propane dehydrogenation (PDH) processes. The company's experience with side stream thermal dynamics and pressure optimisation has contributed to compressor designs that merge complex flow streams while maintaining high polytropic efficiencies. Advanced aerodynamic modelling has expanded the company's stage portfolio for high flow applications. Scalable across the full range of frame sizes, Elliott's centrifugal compressors demonstrate the proven experience required to meet the most demanding downstream applications.

Extending the operating life of critical compression equipment is the mission of Elliott Group's Global Service operations. Whether responding to an emergency, providing original OEM parts, executing repairs to installed equipment, or providing an engineered solution to meet new performance specifications, Elliott's Global Service organisation is recognised for expertise, performance, and responsiveness. Elliott Field Service teams are dispatched from regional locations throughout the world to plan, manage, and conduct planned shutdowns, overhauls, installations and startups, maintenance, repairs, and emergency service for turbomachinery from any manufacturer. Elliott's global network of full-service repair centres delivers expert service to repair and restore rotating equipment from any OEM to 'like new' performance and reliability.

Flexware

Flexware is a turbomachinery engineering company with a focus on improving client equipment performance, reliability and maintenance. The company has years of engineering experience and expertise in equipment design, manufacturing, testing, troubleshooting and performance monitoring.

Flexware provides consulting services, software and training for turbomachinery for the petrochemical and power industries worldwide.

Flexware software and AWM service provides an easy and accurate means of determining equipment efficiency for gas turbines, steam turbines and compressors. The service provides for monitoring of both vibration and performance of turbomachinery including compressors, steam turbines and gas turbines. Continuous trending of vibration and efficiency performance can provide assistance to the maintenance organisation to make the difference between a routine maintenance issue and an emergency situation.

Engineering services include rerates, the design of aero path for compressors and steam turbines along with site efficiency analysis of equipment and aerodynamic and mechanical troubleshooting of equipment and operational problems. Flexware can provide modifications involving efficiency enhancements, capacity or pressure rise.

A recent job for a client in Mexico involved increased head and a broader capacity range while maintaining the constant speed for the gas turbine driver.

Flexware can develop an accurate performance curve for old compressors with minimal input from the client.

Modifications by Flexware include upgrades to sleeve seals for reduced leakage rates and improved life, improved rotor stability via damper bearings or hole pattern seals, performance enhancements by enhancing impellers, rub tolerant seals or other aero hardware.

Flexware has provided customised turbomachinery training worldwide to a broad spectrum of clients for over 20 years.

COMPRESSOR REVIEW

HOERBIGER

What started in 1895 with an epoch-making invention – an innovative steel plate valve for compressors that overcame the disadvantages of valve designs that were common at the end of the 19th century – has developed into today's internationally active and successful HOERBIGER Group.

HOERBIGER Compression Technology, a strategic business unit of the HOERBIGER group, is a world market leader in performance-defining components, systems and services for reciprocating compressors and gas flow control equipment in the oil and gas industry.

Maintaining this leadership in the long-term requires a holistic approach to compressor performance that extends all the way from advanced engineering projects, through comprehensive service agreements, down to the manufacture of state-of-the-art rings and packings.

Modern industry depends on reciprocating compressors for a host of operations: desulfurising crude oil, transporting natural

gas, manufacturing pharmaceuticals, PET bottle blowing, refrigeration plants and vehicle brakes. HOERBIGER's technology is needed everywhere reciprocating compressors are in use.

Keeping compressors working reliably often requires an on-site presence. HOERBIGER Service stays close to its customers through a global footprint of some 80 service locations in 48 countries.

Apart from manufacturing and servicing its own products, HOERBIGER also contributes to the secure and economic operation of entire compressor systems in refineries and chemical plants via tailor-made service contracts. With its integrated engineering approach, known as REE ('Reliability, Efficiency and Environmental soundness'), HOERBIGER focuses not just on individual components or compressors but also on their interaction in the process.

Thanks to the combination of first-rate technology and worldwide experience in compressor service, HOERBIGER delivers outstanding added value to its customers.

HTAC&HGT

HTAC&HGT has been engaged in turbomachine auxiliary equipment servicing for over 30 years. Surface condensers, air cooled condensers and lubrication oil units are the company's key products. Nowadays, the company has cooperated with world-famous EPC companies, turbomachine companies and end users from the oil and gas industry, power plant industry, etc.

The axial exhaust surface condenser, an advanced technology from HTAC&HGT, enhanced its global reputation. In 2019, the biggest one-piece delivered condenser of this type in China has been handed over to a client. The heat exchanger area

is more than 16 000 m², and the total weight is over 300 t. For the Assiut petroleum refining project a skid-mounted condensing system was engineered, which will reduce 93% of the installation work at the site.

The company is dedicated to optimising solutions and providing customers with the best proposal, focused on the technology development and cost-down and effect-up plan.

Recent downstream projects include the KPI Integrated Petrochemical Complex Project in Kazakhstan, as well as the South Louisiana Methanol Project and Side Cracker Project, Total Petrochemicals & Refining, in the US.

L.A. Turbine

L.A. Turbine (LAT) provides custom engineering, design and manufacturing for application-specific, highly engineered turboexpanders used in hydrocarbon processing and other industrial power generation, recovery or refrigeration applications. LAT turboexpander configurations include expander-compressor, expander-generator and expander-dyno (brake) units ranging from 3 kW to 14 MW, capable of handling up to 3000 PSIG pressure, and temperatures between -195°C and 260°C. LAT is also a leading provider of aftermarket service, repair, maintenance and spare part production for all OEM turboexpander makes and models.



A completed ARES AMB unit.

In 2018, LAT brought to market its newest turboexpander design, the ARES Active Magnetic Bearing (AMB) Turboexpander-Compressor for LNG plant sizes of 60 – 300 million ft³/d. The ARES AMB turboexpander features LAT's exclusive skid mounted AMB control system and programmable logic control (PLC) panel. Until now, AMB controllers had to be installed in a building away from the skid installation site. The on-skid AMB configuration gives EPC companies greater flexibility with the plant site layout, accelerates the design to delivery timeframe, and provides an industry-first AMB design technology. The simplicity of design, ease of machine operation, and advanced magnetic bearing technology translates to operational and financial benefits for end users as well. Less time and labour are required for the installation and commissioning of the unit and AMB machines require minor ongoing maintenance. If a machine issue occurs, troubleshooting begins immediately via the remote access capability of the Zephyr® controller.

During 1Q19, LAT built and shipped its first ARES AMB Turboexpander-Compressor, with a flow rate of 200 million ft³/d, to a new NGL processing plant located in the Bakken Shale Play of North Dakota. Commissioning is scheduled for 3Q19.

LAT turboexpanders are designed, engineered and built in Valencia, California, US. Aftermarket service centre needs of the US, Canada, Asia, Australia and South America are fulfilled in Valencia. LAT's European headquarters and service centre, located in Belgium, supports the aftermarket needs of Europe, the Middle East and Africa.

COMPRESSOR REVIEW

MAN Energy Solutions

MAN Energy Solutions is investing all of its energy into creating solutions for sustainable prosperity. By addressing tomorrow's challenges within the marine, energy and industrial sectors, MAN Energy Solutions improves efficiency and performance at a systemic level.

The company provides a wide range of system solutions and services, from single-casing compressors and turbines up to large multi-casing trains for nearly all industrial applications such as oil and gas production, transportation and downstream processing. Full train responsibility with maximum efficiency and reliability throughout the entire lifetime is one of the company's core strengths.

Custom-made centrifugal, axial and process gas screw compressors are capable of handling volume flows up to 1.5 million m³/hr and pressures up to 1000 bar, according to the specific customer requirements. Major references include world scale turbomachinery for oil and gas processing, enhanced oil recovery (EOR), fluid catalytic cracking (FCC), iron and steel production and air separation as well as very large machine trains for purified terephthalic acid (PTA), fertilizer production, and ethylene plants.

With a focus on hydrotreating, hydrodesulfurisation and hydrocracking processes, MAN Energy Solutions used its proven barrel compressor and steam turbine technology to create the high-efficiency modular packaged compressor unit ReTPac® (Refinery Train Package). The modular configuration covers a range of up to 10 MW, with pressures up to 250 bar. The pre-engineered train with its auxiliary system components minimises engineering efforts and as a result considerably reduces delivery times at competitive market prices.

Moreover, MAN Energy Solutions has a long experience in delivering axial compressor trains for different applications, such as the worldwide largest axial FCC main air blower with a capacity of 750 000 m³/hr or the world's largest single industrial compressor, an ASU axial main air compressor with a train capacity of 5000 tpd O₂.

DWE® reactors also belong to the turbomachinery product portfolio. The product range includes reactors and heavy apparatus for chemical and petrochemical processes (e.g. fluid catalytic cracking), as well as physical process systems.

Steam turbines are available for both mechanical drive as well as power generation applications up to 160 MW, while the gas turbine portfolio covers the range between 6 – 13 MW. The company offers the following:

- Compressors:
 - Centrifugal compressors.
 - Pipeline compressors.
 - Integrally geared compressors.
 - Isothermal compressors.
 - Hermetically-sealed motor-compressor systems with active magnetic bearings.
 - Axial compressors.
 - Process gas screw compressors.
- Gas turbines (6 – 13 MW):
 - Mechanical drive.
 - Power generation.
- Steam turbines (1 – 160 MW):
 - Mechanical drive.
 - Power generation.

Mitsubishi Heavy Industries Compressor International

Mitsubishi Compressor International (MCO-I), together with parent company Mitsubishi Heavy Industries Compressor Corp. (MCO), is recognised globally as a premier global supplier of compressor and steam turbine packages for petrochemical and downstream applications. MCO also designs and manufactures compressors and steam turbine packages for a range of applications such as upstream, midstream, downstream and LNG.

A major part of the petrochemical industry is constituted by the plastics (polymer) industry. The global demand for plastics is constantly increasing and therefore there is a significant push to increase the capacity of ethylene plants in order to increase productivity. MCO has over 100 years of experience supplying high quality, custom-engineered, large capacity centrifugal compressors for over 100 ethylene crackers worldwide and other petrochemical plants such as ammonia, methanol, PDH and olefins.

Ethylene plants typically have cracked gas compressor, refrigeration compressors for ethylene and propylene production. The power and efficiencies required for such applications can be achieved by large frame compressors (i.e. compressors with large flow coefficient impellers)

matched with a highly efficient steam turbine. MCO also has experience in supplying steam turbines with varied operating speeds and high power rating, i.e. 90 MW.

The most important thing at refineries and petrochemical chemical plants is efficiency and reliability of rotating equipment. MCO's mission has always been to provide innovative solutions for downstream plants that increase productivity while lowering operational costs. MCO's comprehensive portfolio is not just limited to providing new equipment but also providing services such as field service, repair, maintenance, installation and commissioning, equipment storage, high speed balancing of rotors and foot print replacements. MCO recently had great success by increasing plant capacities by footprint replacements, i.e. the process of replacing an existing steam turbine or compressor rotor or casing with a new machine specifically designed to meet increased performance requirements utilising an existing foundation and piping fit.

MCO's recent projects include compressor and steam turbine packages for the following:

- A 1.4 million tpy ethylene plant and a large 900 000 tpy PDH plant in China.
- A 500 000 tpy PDH plant in Kazakhstan.
- A 5000 tpd methanol plant in Russia.
- A refinery in the Middle East.

COMPRESSOR REVIEW

Petasense

Petasense, an Industrial Internet of Things (IIoT) start-up, was founded with a vision of making industrial machines smarter. The company offers an end-to-end system that provides real-time information about equipment health, leading to reduced unplanned downtime, increased availability and safety.

The key products offered by Petasense are:

- Vibration Mote – wireless, triaxial vibration and surface temperature sensor for continuous condition monitoring of rotating equipment. A compact, battery-powered device that transmits data over standard WiFi to the ARO Cloud.
- Transmitter – wireless, multi-sensor input module that supports up to nine sensor channels. Plug in any third party industrial sensor (4 – 20 mA or 0 – 30 V) and transmit data over standard WiFi. This allows companies to collect asset condition and process data (e.g. temperature, pressure, current, flow, ultrasound, and hundreds of other inputs). Power options include battery or wired (power-over-ethernet).

- ARO Cloud – cloud-based web and mobile applications provide a way to monitor real-time asset health and perform advanced analysis of raw data. Machine learning algorithms, coupled with a comprehensive library of assets and their failure modes, are used to assess the health of equipment and generate a real-time asset health score. It easily integrates with plant systems such as historians, EAM, SCADA, and other analytics platforms. The software combines advanced functionality needed by a vibration analyst, with simple dashboards that are accessible to everyone, providing a single ‘truth’ of asset condition.

Common applications in downstream oil and gas include rotating and static assets, including pumps, fans, motors, electrical panels, steam traps, and valves.

Petasense’s clients include industry leaders in oil and gas, power generation, pharmaceuticals, chemicals, and facility management.

Petasense is backed by True Ventures, Felicis Ventures and top angel investors.

Regal Beloit Corp.

Kop-Flex High Performance (HP) couplings have been supplied to the global oil and gas industry for over 50 years and have amassed over 1 billion hours of reliable operation in API 671 applications. HP couplings are precision balanced and are offered in disc, diaphragm, and gear types. The company’s latest innovation – HP Disc 2.0 – was developed to address rotordynamic challenges presented by the highly efficient, faster turbines of tomorrow. HP Disc 2.0 achieves the lowest overhung moment in the industry (up to 30% lighter) and more sizes to best fit your unique applications. Kop-Flex diaphragm couplings are machined from solid stainless steel forgings with unique profiles per application without welds. For turbomachinery that has been running for decades, the company offers its line of HP gear couplings; or it can assist in retrofitting to a maintenance-free disc or diaphragm coupling. Regal also has a Recertification Program to revitalise couplings.

The Kop-Flex Powerlign® torque monitoring system uses non-contact phase displacement technology integrated into

the coupling to monitor transmitted power between equipment over time and helps diagnose where performance loss is occurring. Recently, a plant was able to retrofit a Powerlign system into its equipment to determine that their production limit was the result of compressor fouling; by implementing an optimised washing schedule, they were able to avoid a US\$2 million capital investment to rerate their steam turbine.

Milwaukee Gear manufactures custom gears, pinions, and assemblies for customers that require helical and spur ground gears to exacting specifications with traceability and reliable lead times. Its expert engineering, on-site heat treatment capabilities and passion for excellence have earned a loyal customer base for over 90 years.

The Kop-Flex and Milwaukee Gear brands are part of Regal Beloit Corp.’s Power Transmission Solutions business segment. Regal Beloit Corp. is a leading manufacturer of electric motors, electrical motion controls, power generation and power transmission products serving markets throughout the world.

S.A.T.E.

S.A.T.E. S.r.l. provides real time (RT) simulation models and software and dynamic simulation services for processes and machines, based on its proprietary software suites, such as TGSim Plus™ and COMPSYS™. These allow the study and design of the physical and of the control systems considering accurate realistic interactions of the rotating machines with plants and all phenomena of relevance in the definition of new installations and products development.

These software products are applicable during the design phase to optimise or check the engineering solutions of the hardware parts, e.g. process control and the piping flow elements and valves.

S.A.T.E. uses its experience to satisfy the industry’s increasing requirements, in particular the trade-off between the need for fast reaction to market changes despite long

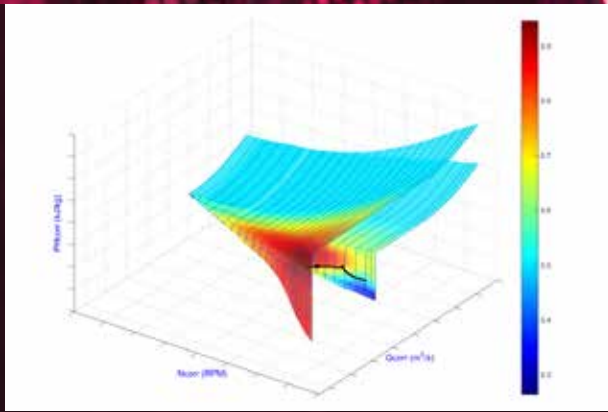
lead item delivery, and the complex system design and integration process for which traditional engineering tools and approaches have become insufficient.

In the last two years, S.A.T.E. has implemented and licensed an RT dynamic simulator of a whole gas turbine system, including all gaseous and liquid auxiliaries, to an international OEM.

The simulator is based on a software suite, TGSim Plus, running in the MATLAB-Simulink environment, which can generate compiled versions of the code to run on RT operating system platforms. The simulator can then be interfaced with the real control system of the plant and used in the following ways:

- For hardware in the loop (HIL) simulations to verify all control system logics and feedback loops.
- As a training tool for the plant operators.

COMPRESSOR REVIEW



Example of compressor multiple map in reduced (corrected) coordinates, for two values of the IGVA, with operating point transition during start-up.

- As a troubleshooting tool to analyse cause-effect relationship in large scale systems, where problems or faults may arise due to complex interactions among physical parts or among them and their controllers, sometimes with large interconnection loops.
- As a design and testing tool for plant diagnostic systems based on simplified model-based or data analysis algorithms that must learn from operational history; in

this case artificial faults injected in the model enable verification if the diagnostic algorithms are prompt enough in their reaction.

One important feature of TGSim Plus relates to one of the key subsystems of the gas turbine, i.e. the compressor.

Although a gas turbine compressor is not affected by complex variations of the properties of the gas being compressed (as air can be considered as an ideal gas), its large air flow requires axial flow compressors with many stages. Their head and compression ratio balancing varies with the operating conditions or during transients such as start-up, which requires multiple surge protection controllers, acting on bleed flows, and accurate mapping of the compressor. In order to better model the stage balancing and to account for the pneumatic and thermal accumulation effects in the stages and ancillary volumes, the TGSim Plus' compressor model (derived from the COMPSYS suite used for process compressors) can be either a single map or a multiple map model, i.e. split into a number of compression stage sets and lumped volume sequences, each characterised by multidimensional maps, i.e. considering several values of inlet guide vane angle (IGVA) positions (see image on p. 92).

Siemens Oil & Gas

Siemens Oil & Gas offers a comprehensive portfolio of turbo



Siemens' SGT-750 turbine will soon debut in its first North American gas process plant application.

and reciprocating compression solutions for the oil and gas industry and other markets. Compressor solutions can be standardised or tailored to meet customer needs in a variety of industries – such as on- or offshore oil and gas production; pipelines; air separation; metallurgy; chemicals, petrochemicals; and refineries, among others. Drive systems employ industrial and aeroderivative gas turbines, steam turbines or electric motors.

Reciprocating compressors range from medium- to high-speed separable units driven by engines or electric motors, to large, slow-speed, motor-driven process reciprocating compressors. Siemens was selected to supply three Dresser-Rand® 5HHE-VL-NL reciprocating compressors for a new,

state-of-the-art steam methane reformer (SMR) in Texas that will become the largest hydrocarbon production unit in the US.

The range of turbocompressors includes integrally geared, single-shaft and axial compressors that can be matched with all kinds of drive systems for highest efficiencies, optimum performance and lowest life cycle costs. For the Encana Pipestone Processing Facility in Alberta, Canada, Siemens was chosen to supply an SGT-750 gas turbine driving two DATUM compressors for gas compression service and an electric motor-driven DATUM compressor for refrigeration compression. This order marks the first North American gas process plant application for the SGT-750 turbine that offers customers a lightweight industrial gas turbine that maintains the robustness, flexibility, and longevity of traditional heavy-duty industrial gas turbines. The DATUM compressor, known for its efficiency, reliability, and ease of maintenance, is ideally suited for the un-spared feed/sales gas and refrigeration compression applications.

Braskem entered into an agreement with Siemens earlier this year to modernise a cogeneration power and steam plant at its petrochemical complex in São Paulo, Brazil, whereby Siemens will implement a fully integrated and redundant equipment solution, including two SGT-600 gas turbines, an E-house, and an extension of the existing high-voltage substation, three reciprocating compressors, an advanced load-shedding system, and associated software for plant control.

Siemens will also supply two SGT-300 industrial gas turbines for an established Montney producer in Alberta, which will mark the first application of an SGT-300 turbine in Canada.

COMPRESSOR REVIEW

York Process Systems

York Process Systems (YPS), a global leader in process refrigeration and gas compression systems, offers extensive engineering, factory packaging, control system, and field service capabilities. YPS provides proven solutions to the oil and gas, and petrochemical industries through manufacturing facilities in the US, Brazil, China, and Europe, and a sophisticated US\$6.7 million high-pressure, high-capacity screw compressor testing laboratory in the US.

The company's equipment has performed in some of the most complicated processes in the most demanding industries for over a century. No matter the application – fuel gas boosting, open cycle process gas compression, or closed cycle refrigeration – and no matter the capacity, YPS offers a large-capacity solution

YPS engineers design the optimum system for specific applications, from utilising Frick® brand screw compressors and York® brand centrifugal compressors in customised



York Process Systems package featuring the 408 SBTP compressor prior to shipment from the facility in Waynesboro, Pennsylvania, US.

systems, to modifying standard chiller products to handle process cooling requirements.

Its broad range of oil-flooded screw compressors includes anti-friction or API 619-compliant sleeve-bearing designs. It also offers a comprehensive selection of high-pressure screw compressors for fuel gas boosting, with capacities up to 8212 ft³/min. (13 952 m³/hr) and 1100 psi (76 bar).

Applications include open systems and closed cycle refrigeration.

Typical installations include natural gas gathering and processing, fuel gas boosting, process compression, and process refrigeration using propane, methane, propylene, ammonia, CO₂ and the latest alternative refrigerants including R-134A, R-507, R-410A. Process refrigeration applications include NGL recovery and dew point control, NGL and LNG boil-off, polysilicon production, industrial gases, chlorine liquefaction, ammonia storage, pharmaceutical manufacturing, downstream petrochemical, and environmental test chambers.

Common drivers are electric motors, steam turbines, and gas turbines. Proprietary microprocessor designs or customised PLC systems using Allen-Bradley or Siemens platforms control the compression and refrigeration systems.

Following successful installation and commissioning, locally-based Johnson Controls/York® factory-trained technicians provide preventive maintenance, troubleshooting, repair, and retrofit services no matter the site.

YPS is a business unit of Johnson Controls Inc., a global diversified technology and multi-industrial leader serving a wide range of customers in more than 150 countries. Its 120 000 employees create intelligent buildings, efficient energy solutions, integrated infrastructure and next generation transportation systems that work seamlessly together to deliver on the promise of smart cities and communities. 🏠