When the pressure is on

High-pressure valves work on top form under high pressure. When the pressure is on, their resilience and flexibility is needed.

Pressures can shoot up very quickly in industries such as oil and gas, process engineering, chemicals and pharmaceuticals. High-pressure valves can alleviate this. They also contribute to the success of the energy transition; when wind power and solar energy drop off, an alternative source of power, such as a combined-cycle power plant, is needed to supplement the power supply. To fill energy gaps, the power plants need robust and powerful high-pressure valves.

Flexibility is a high priority for combined-cycle power plants. “Due to their efficiency and their ability to react quickly to load changes, they are particularly suited to energy generation applications characterised by an increasing proportion of renewable energies,” explains Axel Mücher, owner and managing partner of Schroeder Valves. In this context, as weather-independent generators, they have to compensate for load fluctuations in the electricity grid caused by changing wind and weather conditions.

High demand for minimal flow valves

“The boiler feed pump is one of the core components of these combined-cycle plants,” explains Axel Mücher. It provides the water for the power plant’s steam circuit, bringing it to a pressure of approximately 200 to 250 bar before evaporation. Since it often has to operate in the partial load regime due to the pronounced changes in load due to the system operation conditions, “the minimal flow valve is also working in very demanding conditions. In this partial load operation, it must constantly discharge the pumped media via the bypass, in order to keep the pump in a stable operating range, at the same time reducing the pump pressure of 200 to 250 bar back to

values close to the ambient pressure," says Mücher. Schroeder Valves develops valves especially designed for long-term operation in these wear-intensive conditions.

There is much to be said for the use of combined-cycle power plants, just on economic grounds. Due to the relatively low price of natural gas, combined-cycle power plants are an attractive option to meet increasing energy demands in emerging industrial economies. Combined-cycle installations are therefore, "currently being built in large numbers worldwide," according to Mücher.

Combined-cycle power plant for Malaysia

The rapidly advancing industrialisation of this ambitious emerging economy is having an impact on electricity demand: on average, this is increasing by around four percent year-on-year. In order to keep up with the power demands of its population of 31 million, and the growing number of industrial facilities, Malaysia is investing in the construction of new and efficient power plants.

The Prai combined-cycle power plant is in the town of Seberang Perai in the Penang region. With a capacity of around one gigawatt and an efficiency of over 60 percent, according to the operator it is one of the most powerful and efficient gas-fired power plants in South East Asia. It produces around seven percent of all Malaysia's electricity. The plant is operated by Tenaga Northern (TNBP), a fully-owned subsidiary of the Tenaga Nasional Berhad electric utility company.

High-pressure valves protect pumps

The 50 Hz H-Class power plant built by Siemens comprises two so-called power trains, each consisting of one state-of-the-art gas fired turbine, one water-cooled generator and one steam turbine with auxiliary systems. Two units, each with three centrifugal pumps made by the Korean pump manufacturer Hyosung Goodspring are in use

here. These pumps are protected by six high-pressure valves from Schroeder Valves. The valves can withstand the highest pressures, in order to protect the pumps in the Malaysian power generation facility from the damage that could occur if the minimum flow is not maintained, according to Schroeder Valves' owner, Axel Mücher. The design of the automatic recirculation valve ensures that pumps and installations are protected from the effects of highly fluctuating pump loads and extended operation under partial load conditions. "This is achieved through a special, fully automatic minimum flow control system, which ensures a matched minimum flow."

Combined-cycle power plants gain in importance

The state-owned electric utility Electricity Generating Authority of Thailand has also ordered a combined-cycle power plant. This facility some 40 km south of Bangkok, with a total installed output capacity of 1,200 megawatts, should start supplying around 1.5 million Thai households with electricity from 2019. Siemens is constructing this power plant in a single shaft configuration. "In this construction, the core components (the gas turbine, the generator and the steam turbine) are connected to each other via a single drive shaft," according to Siemens. This plant will be characterised by a high efficiency, short start-up times, and by its flexibility in responding to rapid changes in load. Thailand is dependent on imports of liquefied petroleum gas, so modern, high-efficiency combined-cycle power plants are gaining in importance.

Combined-cycle plants are enjoying increasing popularity worldwide. Siemens has received an order from Panama for six SGT-800 gas turbines. The industrial gas turbines, together with a steam turbine as part of a combined-cycle power plant, will produce around 440 megawatts of electrical power. This will cover the electricity requirements of approximately 1.9 million of Panama's residents.

Supporting renewable energy

A natural gas-fired combined-cycle power plant with a capacity of 1,000 megawatts is being constructed in Lawrence Country, Pennsylvania by Kiewit Power Constructors Co. The North American power plant is designed for rapid, flexible operation, and is intended to support the integration of renewable energies. The inauguration is planned for early 2020. The power plant will provide approximately one million households with electricity.

An existing plant in Marcos Paz in Buenos Aires Province, Argentina will be converted into a combined-cycle power plant in a project called Genelba Plus. The conversion will increase the capacity of the power plant from 168 to approximately 364 megawatts. It is scheduled to come into operation in mid-2019. In 2021, a new combined-cycle power plant in the Republic of Tatarstan in the Russian Federation will start generating electricity. It is planned to have an available capacity of 495 megawatts.

As a replacement for old coal-fired power plants

The Scottish energy company SSE Plc. and Siemens have announced that they are working together to construct the Keadby 2 combined-cycle power plant in Lincolnshire, UK. Siemens will deliver the power plant ready for use. The equivalent of approximately 400 million euros is being invested by SSE in the construction of the new power plant, which will have a capacity of 840 megawatts and an efficiency of 63 percent. Commercial operation of Keadby 2 is planned for 2022, as coal-fired power plants are shut down.

The new combined-cycle power plant in Lincolnshire fits in with the SSE's objective to strengthen its activities in offshore and onshore wind energy. "Combined-cycle power plants will help to flexibly

support the electricity grid. “They provide an important contribution to support the United Kingdom in developing renewable energies and thus achieving its carbon dioxide reduction targets,” Martin Pibworth, SSE’s Wholesale Director, points out.

Renewable energies are also important for the energy revolution in Germany. According to the government, the share of renewable energies in power generation should increase to 80 percent by 2050; its current share is approximately 20 percent. “This energy revolution will only succeed with a restructuring of the whole energy concept,” emphasises the German Aerospace Centre's (DLR) Institute of Propulsion Technology. At the same time, a secure energy supply is essential for Germany as an industrial centre since the economy depends on it. “With significant increases in naturally-fluctuating renewable energies such as wind and solar power, state-of-the-art conventional power plant concepts are needed in order to guarantee security of supply.” The institute favours combined-cycle power plants, which could fulfil the role of fossil fuel support for the energy transition. With over 60 percent thermal efficiency, they are already the most efficient conventional power generation technology on the market.

High-pressure valves for various sectors

Furthermore, electricity from modern combined-cycle power plants produces only half as much carbon dioxide as electricity generated by modern coal-fired power plants. The construction times are also shorter in comparison, and the construction costs considerably lower. Combined-cycle power plants produce both electricity and heat. Manufacturers of high-pressure valves are thus part of forward-thinking power generation technology.

However, combined-cycle plants are not yet running at full capacity. The price of electricity can sometimes be a problem. If the market

price is higher than the cost of generation, operation of the power plant can earn positive profit margins. “If not, the power plant remains shut down and is virtually in standby mode, because otherwise we would have to pay more,” explains Martin Buschmeier, director of the Trianel gas-fired power plant in Hamm. It is calculated that the economical operation of gas-fired power plants on a full-cost basis is not yet possible in the current electricity market.

But this situation will not cause manufacturers and dealers of high-pressure valves any major headaches. There are just too many ways to use them. That is why AS-Schneider designs high-pressure valves for measurement and control technology applications in a wide range of sectors, including chemical and petrochemical plants and the crude oil and natural gas industries. “Pressures here can often reach several thousand psi (several hundred bar), and the process media can be aggressive and harmful to people and the environment,” the company explains. Most valves very quickly reach their limits under these conditions.

Variable modular design

This is how the high-pressure valve is designed: the spindle sealing (packing) is made from the polymer PTFE. “Furthermore, the high-pressure valves benefit from a metallic rear seat, which provides an additional seal against the outside environment, reducing the demands on the packing,” according to AS-Schneider. This results in both reduced wear and in the valve being blow-out proof.

The modular design allows many configuration options for the high-pressure valves in terms of function, material choice, type of connection and application area, explains Göpfert AG. In addition to shut-off valves, examples include control valves, non-return valves, strainers, valves for panel mounting, valves with cutting ring fittings or with welding ends, and valves with an external spindle thread. “As

well as traditional hand wheel operation, our high-pressure valves can also be fitted with actuators for use as automated valves," the company states.

The tightness is also important, Bürkert adds. The pre-controlled valve with servo piston and two way pre-control has an additional radial seal and "enables very good tightness", according to the company. The high pressure design covers pressures up to 250 bar.

Fossil and nuclear power generation

Schroeder Valves is active as a manufacturer of high-pressure valves in the areas of fossil and nuclear power generation, as well as descaling in steelmaking. The company's high pressure range starts at the PN250, or class 1500 lbs, pressure rating. In classic (minimal flow valve) applications, this corresponds to operating pressures from approximately 140 bar, and goes up to approximately 400 bar. There are even application areas for high-pressure valves with operating pressures of several 1000 bars. The materials typically used in Schroeder Valves' application areas are hardened martensitic steels.

"For minimal flow valves, the classic application is in the boiler feed water areas in fossil fuel and nuclear power plants, where to increase efficiency, the water is first brought to a high pressure before it is vaporised by the addition of heat and discharged through a turbine," owner Axel Mücher explains. Other fields of application are the descaling of rolled metal in steelmaking, which involves using a high pressure water jet to blast the unwanted scale layers off the steel, and water injection, whereby high pressure water is injected into an oil or gas field to increase the pressure inside the well and thus increase the flow rate.

Weight reduction as a target

Particular situations require special measures: high pressures cause very high forces on the walls of the pressurised parts of a valve, which in itself requires a thick construction. “The amount of material used and weight reduction therefore play a role for purely cost-based reasons,” says Mücher. Therefore, in terms of the geometrical design, one tries to enclose the pressurised volume in the most efficient and material-saving way.

One must also remember that valves must be integrated into pipelines, where their weight sometimes causes high operating forces, which must be borne by appropriate supporting structures. Mücher continues: “Any possible material-efficient design is also in the interests of the user here.”

Users therefore pay close attention to quality, costs and criteria such as weight reduction. Manufacturers of high-pressure valves who do not want to come under pressure themselves must prepare for this. Then your business can run at full speed. Innovations in the fields of valves and associated products will be presented at the world`s no 1 fair for industrial valves, VALVE WORLD EXPO, from December, 1-3, 2020 at Düsseldorf Fairgrounds.

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