Egypt Megaproject sparks change of Siemens’ project organization

Lean and project-centred is how Siemens has evolved in the wake of the €6 billion Egypt order, the largest in the company’s history. “For the first time, we have set up a specialized front office in-country which differs from our established matrix organisation,” Peter Ullrich, overall project director CCPP Megaproject Egypt told Gas Power Tech Quarterly.

Project-centred and local decision making is vital for Siemens to smoothly execute the Egypt Mega-order. “Lean management is the way forward,” he said, indicating this approach will gain traction throughout the company.

On the ground in Cairo, Mr Ullrich is busy coordinating and supervising the simultaneous execution of three large power plants: Beni Suef, Burullus and New Capital. Each of the combined-cycle units has a nameplate capacity of 4.8 GW, and once operational in December 2018 the three plants will boost Egypt’s installed power generation capacity by 14.4 GW.

By relocating to Egypt for the duration of the project, he gained valuable insight in the local culture and can make time for multiple meetings, including informal ones. Ministers, consortium partners ElSewedy and Orascom, lead engineers and workers who prepared the ground for the power plants – Mr Ullrich has met them all, and found ways of communicating with them effectively.

“It was a challenge, initially, but also an interesting learning curve,” he said, recollecting memories about some meetings with consortium partners when time schedules and manpower was discussed. Knowing how to address critical matters and how to suggest changes – in the face of tight budgets and time constraints – is the type of cultural awareness that makes or breaks projects.

MAN launches powerful four-stroke engine

"Pushing the limits, the new MAN 20V45/60 engine achieves a power output of 26 MW at a considerably lower fuel consumption than its predecessor, the MAN 48/60. At the launch event in Augsburg on September 11, the new flagship genset was presented as “the most powerful four-stroke engine in the market.”"

Innovative engineering, combined with MAN’s rich experience with four-stroke engines, has inspired the newly-designed 20V45/60 which expands the current performance range of MAN’s 4x family of diesel engines by more than 4 MW and offers over 50% fuel efficiency.

With these metrics, the new flagship engine allows MAN’s customers to save both investment and operational cost, according to Wayne Jones, Chief Sales Officer. “We were aiming for a game-changing level in power density and efficiency, and we accomplished that mission,” he pointed out.

“Next to a frontloading approach, using thermodynamic engine process calculations, MAN engineers used computational fluid dynamics to simulate and optimize the combustion process. Finite element analysis was also used to optimize the engine’s mechanical strength and vibration behaviour”, explained Dr. Gunnar Stiesch, Head of Engineering Engines at MAN Diesel and Turbo: “We then put the power unit to the test on the world’s largest four-stroke, single-cylinder test bed and started the experimental optimization and validation phase.”
In addition to the Cairo front office, there is also a management and engineering setup in Offenbach, and SPEL engineering in India helps as well to support the Egypt order execution.

Order win & financing
Securing the order was finalized in the Egypt Economic Development Conference at Sharm el Sheikh. “Joe Kaeser and President Al-Sisi shook hand on this deal. It was Al-Sisi’s decision to trust Siemens with this enormous national power project,” Mr. Ullrich said, underlining most Egyptians have a positive perception of German products.

The loan agreement for the Beni Suef project was signed in November 2015, followed by financial close for Burullus and New Capital on March 31, 2016. The credit facilities, agreed on for the three projects, are secured by export credit agencies, notably the German Hermes cover.

The substantial order volume consists of 2 billion Euros each for the three Combined Cycle Power Plants (CCPPs), another 2.3 billion for 12 wind power farms at the Gulf of Suez and in the West Nile area (2GW total capacity) and an additional 200 million Euros for six 500 kV power grid substations.

Site-specific challenges
Though Beni Suef, Burullus and New Capital are designed as almost three identical combined-cycle power plants in 2-on-1 configuration, they are being built on three completely different sites. Hence, ground preparations works and related costs differ significantly.

“The least challenging site preparation was in New Capital, as it is located in the desert with almost no levelling and easy to reach – only 60km from the centre of Cairo.”

“Beni Suef is situated 150km upstream on the river Nile and the site has a height-difference of 40 metres between the river and the serving area, which means that about 1.6 million cubic metres of rock had to be excavated and removed,” he explained. More time for site preparation and more cost were incurred for that project.

“Most challenging, by far, has been Burullus. The project site is in a soft, swampy area nested between a lake and the Mediterranean coast, that’s why a lot of concrete had to be driven into the ground, at significant cost. Accessibility of the site was only possible via a small road with a lot of bridges. So rather than fortifying the bridges, we’ve spent some 5 million Euros on enhancing a small fishing port. International banks (incl. Euler Hermes coverage) are financing up to 85% of the CCPPs and the remaining 15% are covered by the Egyptian government.

Asked why the Egyptian government had insisted on such a challenging site, he said this was the customer’s explicit wish. The actual site of the Burullus power plant, like much of Egypt’s land, is owned by the military so there might be some strategic reason for having new-build power generation capacity just here. The site between Alexandria and Port Said already hosts two cities with refineries and fertilizer industries and there seem to be plans to further develop area.

Cooling can be a major challenge in locations with high ambient temperature, such as Egypt. At Beni Suef and Burullus, Siemens is using cooling towers (only at Beni Suef using Nile water as Make up water resource) – “a standard procedure,” according to Frank Strobel, Siemens’ responsible thermodynamic expert. At New Capital, meanwhile, it is dry-cooling by means of an air-cooled condenser – “typically done in regions with little or no water.”

Sequential startup
The first milestone of the CCPPs, which is the connection of 11 gas-turbines to the grid in open cycle operation, was achieved in only 18 months with an additional gas-turbine way before schedule. This constitutes 4.8GW fed into the Egyptian grid.

Commissioning and startup of the three Mega-CCPPs will be organized in a sequential way: Beni Suef is the plant with the best grid connection and most energy demand in the local area; hence the project is first in line. Groundbreaking took place in late August 2015 and the commissioning will be carried out between January and October 2018.

Start-up of the two other 4.8 GW power plant will follow in short succession so that by the end of December 2018, an envisaged total of 14.4 GW will be added to the Egyptian power grid. At full operation, these three CCPPs can cover up to 50% of Egypt’s electricity demand.

With its 95 million citizens, Egypt’s energy demand is driven by demographics and economic expansion. By 2025, around 109 million people are anticipated to live in Egypt and by 2050 that number will rise to 151 million, according to UN World Population Prospects. Combined with demand from industry, Egypt’s total power need is rising at more than 4% per annum.

Flexible power supply from the three CCPPs will help prevent power cuts and blackouts, which were for a long time a recurring reality in Egypt due to low reserve margins and a lack of stable baseload generating capacity. Together with its local partners Orascom and El Sewedy, Siemens will help boost Egypt’s installed capacity by more than 45% – through the three CCPPs, but also via the 2 GW additional wind power capacity.

Where to go from here
Order-wins like the one in Egypt are rare to find, but GPTech Journal asked where Siemens might be looking to replicate this order. Energy-hungry countries with substantial financial backing in the Middle East come to mind, notably Saudi Arabia.

Mr Ultrich pointed out the precondition for an order of this size is that there was a political interest, at European level, to stabilize Egypt as a country. Eliminating power shortages gives the Egyptian government political backing.

“My key take-away is that if there is a political will (in a country), you can do almost everything,” he concluded.
LMS100 gains traction, beats LM6000 in total order wins

“General Electric’s LM6000 gas turbine has long been the sales champion of the GE aeroderivative fleet, but the LMS100 is now giving it a run for its money,” independent consultant Mark Axford told Gas to Power Journal. The LMS100 beat the LM6000 in total orders for the first time in 2015. This included two installations on behalf of Exelon Medway in Massachusetts, five for Arizona Public Service, five for NRG Energy and four for LNG Canada in British Columbia.

Total M6000 unit orders in 2015 dropped to 14, with only two sold in the U.S. - the lowest order rate for LM6000s since 1992. Outside of North America, on unit was ordered in Argentina. That took the LMS100 order total to 57 units in the U.S. and 23 in the rest of the world. Each one is for simple cycle operation.

“When the totals for 2016 are announced, it will be interesting to see if 2015 was a one-off or it represented a shift in gas turbine buying trends,” he said. “The faster you can achieve a large fleet, the more orders you are going to accumulate. Once a large user base develops, you also see the development of best practices.”

California leads the way, needs grid balancing

Southern California hosts a large number of LMS100 installations: 19 of the first 54 LMS100s sold were to customers in California as the state pushed towards 33% of electricity coming from renewable sources by 2020.

The California ISO area needs machines that can respond quickly to match the total load demand of fluctuating renewable power while maintaining grid stability. As much as 15,000 MW of renewables can be available to the state’s grid at any one time. This has made up 40% of overall load at some points. And the volume is only going to grow. Almost 8,000 MW of solar is being installed on California roofs every month. With increasing dependency on solar, the challenge is a huge late-afternoon drop-off in solar generation at the same time demand spikes. In November 2015, for example, 10,000 MW had to be added between 5 PM and 9 PM by bringing other power assets online rapidly (see graph).

The Los Angeles Department of Water and Power (LADWP) is on track to have 33% of its capacity coming from wind and solar by the end of the decade. Thus it is experiencing similar ramping issues as those facing the state as a whole. In response, LADWP has been placing GE’s LMS100 aeroderivative gas turbine at several of its facilities. Its generating capability was recently uprated to 110 MW and it has the ability to reach full load in 10 minutes.

Haynes Generating Station in Long Beach, California, was the first to go online with the LMS100 in LADWP. It opted for six LMS100 simple-cycle gas turbines rather than one large combined cycle unit due to the need to ramp up and down to cope with renewables and provide power in any increment between 50 MW and 600 MW.

“The six LMS100s at our Haynes facility have been successful in meeting peak power demands and providing a quick response to unscheduled loss of transmission or generation assets,” said Sungly Chiu, Power Engineering Manager for LADWP.

Chiu noted that the utility is using these machines far longer than it originally envisioned. On a typical day, a unit may be placed online around 2 pm and could operate until 8 pm. While the typical LMS100 averages over 90 starts per year, two additional LMS100s have been fitted with clutches by SSS Clutch and have been running almost continuously in synchronous condensing mode with approximately 30 to 60 starts a year. They provide enough reactive power to support the grid and allow the importation of power from remote renewable sources. These overrunning clutches sit between the turbine and the generator so that those units operate as synchronous condensers and supply reactive support.

“One of the most valuable investments for the Haynes Repowering Project was the inclusion of the clutch system for the LMS100 units,” Chiu commented, adding LADWP also introduced two LMS100 simple cycle gas turbines at its Scattergood in Los Angeles. They also are used as quick response peakers and came online last year.
Electric cars could propel up UK power demand 18 GW by 2050

National Grid projections show that growing use of electric vehicles in the UK could increase peak power demand by 3.5 GW by 2030 and 18 GW by 2050. Today, UK peak power demand is approximately 60 GW. Under the “Consumer Power Scenario,” National Grid anticipates electric vehicle (EV) sales to account for more than 90% of all cars by 2050.

This would by the end of the decade increase the number of electric cars on Britain’s roads to 1 million, rising to nearly 9 million by 2030.

In a Consumer Power world there is high economic growth and more money available to spend. Consumers’ appetite for the latest gadgets drives innovation and technological advancements, while environmental awareness is limited. Market-led investments mean spending is focused on sources of smaller generation that produce short- to medium-term financial returns.

Electricity demand would surge in this scenario, driven initially by rising EV market penetration and in later years also by demand for electric heating. The scenario calculates peak power demand under the assumption that consumers would charge their electric cars whenever it suits them best, also during peak hours.

The “Two Degrees Scenario”, meanwhile assumes that consumers make conscious choices to be greener and can afford technology to support them. With highly effective policy interventions in place, this is the only scenario where all UK carbon reduction targets are achieved.

“Slow Progression” anticipates low economic growth – hence affordability competes with the aspiration to decrease carbon emissions. With limited money available, the focus is on cost-efficient, effective policy intervention which is expected to lead to a mixture of low carbon technologies and high levels of distributed generation.

The “Steady State” is the least affluent of the scenarios and the least green. There is little money or appetite for investing in long-term low carbon technologies, therefore innovation slows while industry stakeholders try to maintain security of energy supply.

Gas is deemed ‘critical’ to security of supply under any of these four scenarios, and forecast to have a long-term role as a flexible, reliable and cost-effective energy source as Britain is transiting to a low carbon future. Consequently, natural gas as a fuel could provide twice as much electricity annually as it does today, and this ratio could rise even more by 2050.

Moreover, decarbonisation of heat needs to pick up pace now if the Government wants to meet its 2050 carbon reduction targets, with National Grid highlighting the role gas, and the potential future use of hydrogen.

Offering ‘low carbon heating packages’ help empower UK consumers

Decarbonising heat is cheaper than tackling emissions in many other sectors, according to the Energy Technologies Institute (ETI) who calls on policy makers to adopt an “integrated systems approach” across Britain to show how low carbon heat provision delivers consumer-value. According to ETI chief engineer, Andrew Haslett, “the challenge is one of replacing natural gas-based heating in its present form, possibly by allowing consumers to buy low carbon heating packages.”

“Most of the technology to deliver low carbon heating is known, it is simply underdeveloped in practice so it needs to be proven and proven at scale,” he said but cautioned that the same solution will not suit everyone.

“It is probably time to start seeing heat as a service people want to pay for – so setting a unit price for energy consumption is the wrong place to start from,” he stressed. In contrast, enhanced heating control and information are believed to “help people value and control what they spend.”

In Mr Haslett’s view, “the future could see people buy low carbon heating packages like they buy mobile phone packages today.”

“Decarbonising domestic heat is very complex from a systems integration challenge, but it remains one of the more cost effective ways to tackle emissions in the UK, especially when compared to the cost of making deeper cuts in other sectors such as aviation and industry,” commented ETI chief engineer, Andrew Haslett.

“The future of heating in the UK will be different, but at the moment no one fully understands quite how different. The challenge is one of replacing natural gas based heating in its present form. But consumers are not presently engaged to change their heating systems to combat emission reductions.”

More ‘real consumer’ data is needed e.g. by testing different types of low carbon technology in homes, to help understand what motivates consumers, what improves the heat experience for them and how installations can be simplified to ensure they are more convenient and barriers to adoption are removed. The institute also called for more local area energy planning, underlining its “vital role” in identifying, building consensus and developing coherent low carbon transition plans to build business confidence to invest.

“The future of heating in the UK will be different, but at the moment no one fully understands quite how different. The challenge is one of replacing natural gas based heating in its present form. But consumers are not presently engaged to change their heating systems to combat emission reductions.”

ETI’s research shows there are pathways for decarbonising domestic space and water heating; and before the end of 2017 the institute will be releasing technical data and reports from projects delivered across its technology programmes over the last 10 years.
Maintaining energy efficiency over the plant lifecycle

Fuel costs account for up to 80% of a power plant’s operating expenses but Wärtsilä Services Manager Markus Åbrant underlined “the financial rationale is not the only one that speaks for fuel and energy efficiency.” Enhanced operational efficiency, extended lifecycle of the equipment and a more sustainable brand image are, in his view, valid reasons for considering an energy efficiency improvement project.

In today’s uncertain economic environment, increases in profitability are often sought through tightened cost control,” he said, underlining the need to think long-term by considering fuel burn and operational efficiency over the plant’s entire lifecycle.

Energy efficiency of power plants can be kept up over their entire lifecycle by analysing the true condition of the installation, carrying out maintenance in accordance to the plant’s operational profile and conducting the most suitable lifecycle upgrades. With well-planned, data-driven maintenance services, the plant can be operated more efficiently and the lifecycle of the equipment can be extended.

“Maintenance is a key aspect in upholding a power plant’s energy efficiency. A modernisation or conversion can significantly reduce energy use, but keeping the energy consumption of the plant on the same low level continuously requires regular maintenance,” Åbrant explained.

“Equipment condition monitoring and data analytics provide valuable information that allows us to predict maintenance needs. With these digital services, we can detect potential performance issues and take corrective measures quickly.”

With Wärtsilä Guaranteed asset performance, the Finish manufacturer helps ensure the reliability or availability of a power plant. Performance targets are set together with the customer, and Wärtsilä ensures that they are reached, e.g. through a module which measures and monitors fuel efficiency, and gives customer optimisation advice.

Upgrading and modernising power plants

Equipment modernisation reduces fuel consumption and thereby lowers fuel costs. Customer needs can be determined together with an audit to establish which solution is best suited to different phases of the engine, or power plant lifecycle.

“Converting an existing engine to operate on gas can offer significant benefits both economically and environmentally. Natural gas is attractively priced, and its emissions are lower,” Åbrant stressed.

In a lifecycle upgrade, meanwhile equipment is upgraded to meet its original running parameters. The condition of the power plant is analysed and actions are suggested to correct excessive de-rating, in order to restore its operating efficiency to its original state or beyond.

An alternative is an engine performance upgrade, generally based on the latest turbocharger. Higher pressure ratio capability, combined with optimal engine settings, improves engine efficiency, while the optimised combustion reduces exhaust gas emissions.

With a combined cycle upgrade, more power can be produced with the same amount of fuel by applying waste heat recovery steam generators connected to common steam turbine generator sets. According to Åbrant, “the boost in energy output can be as much as 10%.”

More information about extending the plant lifecycle through upgrades can be found in this whitepaper.

Kiisa emergency reserve power plant in Estonia

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Singapore seeks to become 1st fully data-driven city worldwide

Aspiring to fully digitalize its infrastructure, Singapore is piloting ‘MindSphere’ – Siemens’ open, cloud-based operating system for the Internet of Things (IoT). To that end, the German OEM inaugurated a digitalization hub in the city state, supported by the Singapore Economic Development Board (EDB), were it will develop IoT and Industry 4.0 solutions in collaboration with customers in Southeast Asia.

MindSphere provides a platform for connecting infrastructures in different industries: Apps and digital services, e.g. to analyze big data, can be managed on the operating system to help customers gain insights into optimizing complex systems.

As part of the Digitalization Hub, Siemens will also intensify cooperation universities. Nanyang Technological University (NTU) Singapore has committed to create data-driven innovations for urban infrastructure, e.g. mobility solutions based on self-driving vehicles, and advanced data analytics for optimizing the performance of green buildings.

SP Group, Singapore’s sole power TSO, has agreed to cooperate on building a energy management software for SP’s 24/7 control centers to enable more robust planning, surveillance and predictive maintenance of the country’s power network. They will also create a multi-energy urban microgrid solution to help consumers save energy and cost.

The Hub will bring together data scientists, solution architects, software engineers, system experts and domain specialists from the urban infrastructure, industrial and healthcare sectors. They will develop, test and commercialize innovations and future-ready digital solutions. Starting with 60 specialists from a variety of disciplines, the Hub team is expected to grow to 300 by the year 2022.

“Singapore is one of the greatest economies in the world. It is known for excellence, long term planning and forward thinking. Siemens will be key partner to help prepare Singapore for the new digital economy.

“Piloting MindSphere as the IoT operating system, Singapore has a unique opportunity to become the leading fully integrated urban ecosystem on the globe,” Joe Kaeser, Siemens President and CEO, said at the opening event on Tuesday.

EDB chairman Dr. Beh Swan Gin added he believes that partnering with Siemens will support Singapore’s move to become a Smart Nation. By leveraging their MindSphere operating system, the new Hub is expected to create new opportunities for businesses to tap onto Singapore’s rich digital ecosystem to co-develop innovative digital solutions.

More and more cities becoming “smart”

Around the global a rising number of metropolises are taking a strategic approach to become smart and their number has risen to 35 last year up from 17 in 2014. As cities and infrastructure operators seek to develop IoT applications to relieve traffic congestion, conserve water and energy and improve infrastructure services, this will open up completely new markets for technologies and services.

A McKinsey report from 2016 estimates around $49 trillion will have to be invested in infrastructure projects worldwide between 2016 and 2030 to underpin rates of expected economic growth. Approximately 60% of these investments would have to be made in emerging markets.

This trend drives growth in the global market for smart city solutions. According to Navigant Research, this market will grow by 10% annually, from $40 billion in 2017 to $98 billion in 2026.

Ultimately, however, all of these services are based on data — and that raises concerns about a “big brother” state. Not at all, says Gerhard Engelbrecht, expert in intelligent information and communications technology (ICT) at Siemens Corporate Technology. “We are aware of this sensible topic and have designed the system accordingly, that only anonymized and aggregated information can be used for research.”

Carlo Ratti, an architect, engine, and professor at MIT’s Department of Urban Studies and Planning, added that cities will, in fact, not change much in appearance – its rather “what will change, however, is the way we experience cities,” he says, suggesting our cities are increasingly turning into “open-air computers.”
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Japan takes “more measured approach” to IGCC deployment

Suspension of the ambitious Kemper integrated gasification combined cycle (IGCC) has amplified concerns over the prospects of this technology, but IEA chief economist Lazlo Varro points out that “more promising developments of projects using IGCCs can be found in Japan.” The Osaki CoolGen project, in his view, has taken a “more measured approach to scaling-up IGCC deployment,” commissioning a 166 MW oxygen-blown IGCC plant in March.

The Osaki CoolGen Corporation was established in 2009 under joint funding by Electric Power Development (J-POWER) and The Chugoku Electric Power. Leveraging expertise gained from the EAGLE project, the Osaki venture is a 166 MW oxygen-blown IGCC demonstration plant (coal feed rate of 1,180 tonnes per day), situated at the Chugoku Electric Power Osaki Power Station in Osakikamijima, Hiroshima prefecture.

To date, the Osaki plant has completed over 500 hours of testing and the project owners plan to add CO2 capture at a later stage. “The potential attractiveness of IGCC is its very high efficiency and low emissions relative to other coal technologies, and the ready CO2 stream generated pre-combustion,” Mr Varro commented. “Nevertheless, the prospects for the technology are uncertain, and the developments at Kemper only amplify concerns.”

Kemper adds to line of IGCC failures

The track-record of IGCCs is not all that promising, and Kemper is not the first high-profile failure of an IGCC with an integrated carbon-capture storage (CCS) plant: The original US FutureGen project had set its sights on a large-scale IGCC before it was cancelled in 2008. ZeroGen, another abandoned project in Australia, ZeroGen, also aimed to build an IGCC with CCS plant, before detailed engineering (including of the CO2 storage) revealed an almost A$7 billion price tag.

“Arguably, Kemper has now tested the veracity of those estimates from the other side of the world,” Varro commented.

Petra Nova delivered on time and on budget. But there are also success stories of CCS deployment in the United States, notably the commissioning of the Petra Nova project in Texas earlier this year. Petra Nova is the second, and much larger, project to retrofit post-combustion capture technology to an existing coal-fired power station, with costs reportedly around 20% lower than the world-first effort at Boundary Dam in Canada.

“The Petra Nova approach may not have all the bells and whistles of Kemper but it has proven to be a more reliable and affordable option,” Mr Varro said. “Remarkably (for a CCS project), it was delivered on time and on budget.”

China gasifies coal to curb air pollution

China’s National Energy Administration is targeting to produce 50 Bcm of gas from coal by 2020, enough to satisfy 10% of gas demand from industries and power producers. Turning to coal gasification would allow China to utilise a domestically abundant fossil resource in a cleaner way, while reducing dependence on Russian pipeline gas or LNG imports.

Domestic resources

With this technology, the Chinese government seeks to exploit stranded coal deposits as transporting gas is cheaper than transporting coal. NDRC, China’s powerful National Development and Reform Commission, has been advancing plans for gas supply capacity to exceed 260 Bcm, underpinning a 16.2% growth gas-fired capacity to reach 56 GW/year.

Anticipated gas demand of 260 bcm per year is aimed to be met by about 140 bcm/a locally produced conventional gas, 30 bcm/a of coal-bed gas, 6.5 bcm/a of shale gas – which still leaves a need for importing up to 50 bcm/a of pipeline gas and around 38 bcm/a of LNG.

“China’s push into large-scale unconventional gas and synthetic natural gas development will well ensure fuel supply security for gas-fired power generation capacity expansion in China, which now takes approximately 20% of total gas consumption,” said Prof. Hua Ben, director of the Natural Gas Utilisation Research Centre at South China University.

High carbon footprint

Though coal gasification can be attractive from an economic and energy security perspective, its overall carbon intensity is actually worse than coal mining. Hence the International Energy Agency (IEA) does not deem it attractive from a climate change point of view.

Underground coal gasification has two wells drilled into the coal mine, one for injection of the oxidants, another to bring the produced gas to surface. High pressure break-up of the coal with water (hydrofracking), electric-linkage and reverse combustion have all been used in the gasification process, according to the UCG association.

Still, the process of coal gasification actually produces more carbon emission than a traditional coal-fired plant, which partially undermines the environmental agenda. According to a study by Duke University, synthetic natural gas when burnt produces seven times more greenhouse gases than natural gas, and almost twice as much carbon as a coal-fired power plant.
Nickel-based turbine blades, used in such combustion systems, already melt at temperatures 200 degrees Celsius lower and hence require air-cooling. Yet, operating temperatures of gas turbine combustion systems can occasionally exceed 1,600 degrees Celsius.

Researchers at Kyoto University found out that fabricating molybdenum silicide-based composite - by pressing and heating their powders (powder metallurgy) - improves resistance to fracturing at ambient temperatures. However, this process also lowers the material’s high-temperature strength, owing to the inclusion of silicon dioxide layers within the material.

Using ‘directional solidification’, the team managed to fabricate their molybdenum silicide-based materials. The team found that a homogeneous material could be formed by controlling the solidification rate of the composite during fabrication, and by adjusting ternary elements added to the composite.

Tantalum increases material strength
“The new material only starts to deform plastically under uniaxial compression above 1,000 degrees Celsius,” researchers said, adding the material’s high-temperature strength increases through microstructure refinement.

“Adding tantalum to the composite is more effective than adding vanadium, niobium or tungsten for improving the strength of the material at temperatures around 1,400 degrees Celsius,” they pointed out.

In a report, published in the Journal Science and Technology of Advanced Materials, the researchers pointed out that alloys fabricated at Kyoto University are “much stronger at high temperatures than modern nickel-based superalloys as well as recently developed ultra-high-temperature structural materials.”
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Honeywell- Integrated Systems for Biomethane Grid Injection

Honeywell’s Elster® Precision Solutions enable biomethane producers to safely and reliably inject upgraded biogas into the local natural gas grid while complying with all relevant regulations.

The global shift in the use of energy from conventional resources to unconventional or renewable resources is the main factor driving the growth of the biogas market. Various government and environmental regulations are supporting and influencing this worldwide trend.

Biogas plants with upgrading and injection facilities place new demands on gas measurement, particularly on gas quality analysis. In the case of injection systems, gas quality specifications must be complied with and monitored using metrological technology - all this while adhering to official fiscal gas measurement requirements.

Gas distributors must measure both the quantity and quality of gas before allowing it to enter the grid, or reject the gas if it does not meet quality standards. They also require solutions to control pressure and add an odorant to the gas, which is stipulated for safety reasons in case of leakages.

Honeywell has the broad and deep experience and technology to address this need with our comprehensive Elster Precision Solutions. We supply complete packages for all measurement and control tasks necessary for biomethane grid injection.

**Proven and Reliable Solution**

Biogas producers around the world seek proven and reliable technology for injecting upgraded biogas into their local natural gas grid, while complying with all relevant regulations. They need a grid injection system offering a combination of high availability for the supplier and maximum security for the grid operator.

With one of the most comprehensive portfolios in the natural gas industry, Honeywell can build turnkey systems that handle fiscal measurement tasks, odorization, and compression and blending with liquefied petroleum gas (LPG) to condition the biomethane to the required quality.

Honeywell’s tailored solutions are offered to both biogas suppliers and grid operators. They include compact and cost-effective systems to inject biomethane into low-, medium-, and high-pressure gas grids. These systems are supported by best-in-class gas measurement and control technology and proven industry domain expertise.

**Applications**

Honeywell’s Elster Precision Solutions include gas-to-grid injection systems configured to meet a wide range of application requirements. These flexible systems are easily customized to comply with the user’s individual specifications – from simple to complex. Subject to local requirements, they can comprise any of the following components:

- Integrated control system
- Gas pressure control equipment
- Compressors
- Odorizing station
- Analyzers
- Remotely operated valves
- Electric ball valves
- Particle filters
- Propane injection and mixers
- Flow meters
- Pressure and temperature sensors
- Gas chromatographs
- Network telemetry equipment

In the UK, Honeywell’s Elster gas experts partnered with the biogas industry to provide the first commercially built Grid Entry Unit (GEU). Our grid injection system is fully compliant with GS(M)R and OFGEM regulations. It is available as either a three- or five-compartment solution.

For the French market, Honeywell developed a compact system to inject biomethane into low- or medium-pressure gas grids. This solution includes, fiscal metering, pressure control, analyzer system, Odorization and a PLC-based control system with telemetry communication capabilities.

**Gas quality control**

The feed of biomethane into the pipeline network in some cases requires conditioning of the gas to fit the calorific value of the pipeline gas. This conditioning of biomethane can be accomplished by blending the gas with LPG. The quality control as well as the conditioning of the biomethane requires continuous and accurate measurement of the gas composition.

Honeywell answers this challenge with the EnCal 3000 gas chromatograph, which has been adapted to measure all main components of biomethane including H2, O2, and H2S. This application is approved by the PTB, LNE and OFGEM for use in metrologically approved metering systems in Europe.

**Why Honeywell**

With Elster Precision Solutions, Honeywell offers an extensive, end-to-end solutions portfolio for gas and liquid metering, and control applications in the oil and gas industry.

Honeywell has proven experience meeting the needs of local gas distributors and grid operators across the globe. We provide seamlessly integrated solution packages – delivered by a single, trusted supplier – for all measurement and control tasks in biomethane grid injection systems:

- Full, turnkey biogas-to-grid-systems
- Comprehensive engineering, procurement and construction (EPC) service
- Design and build to meet any site requirement
- Full compatibility with local/regional/national operator specifications
- Ongoing maintenance and service support for grid injection equipment

For More Information:
To learn more about how Honeywell’s Elster Precision visit www.honeywellprocess.com or contact your Honeywell account manager, or authorized distributor.
DILO, a German manufacturer of sulfur hexafluoride (SF6) gas handling equipment, has launched a SF6 multi-analysers that allows users to simultaneously check three key gas quality parameters - SF6 concentration, humidity and quantity of decomposition products. SF6 quality of gas insulated equipment needs be checked to determine if the gas still complies with the IEC Standard 60480 (SF6 reuse) or whether it needs purification.

Humidity in the gas, which can get in through improper gas handling or leaks in the gas compartment, is a significant quality indicator. In the event of discharges, the humidity acts as a reaction partner and, alongside the discharge energy, is a determining factor in the extent of the resulting concentration of decomposition products. In high concentrations, the insulating properties of the gas can also be reduced by gas humidity.

Other important factors to consider are decomposition products, which can result from discharges, as these are often toxic and corrosive. To determine whether there is a high concentration of such discharges, researchers are using the concentration of sulphur dioxide (SO2) as an indicator for the total concentration of decomposition products.

Air content which can get into the gas compartment as a result of improper handling is hereby estimated indirectly from the percentage measurement (SF6 concentration).

DILO said its SF6 multi-analysers feature integrated batteries that allow the device to work in a self-contained manner. Given that a gas sample can not only be stored inside the device and then fed back into the gas compartment; the product upgrade now offers other option for handling these gas measurements. With the new device, it is now also possible to store the measuring gas directly in cylinders or containers with pressures of up to 10 bar without disconnecting the device from the gas compartment.

Cylinders, or containers with a pressure of up to 35 bar, can be directly connected to the device without additional pressure reducer. According to DILO experts, “this makes handling of the measuring gas easier and speeds up the measurement process.” Furthermore, the SF6 Multi-Analyser allows users to connect external measuring gas collecting bags so that continuous measurements are made possible.
Electrify Europe is the world’s first event dedicated to the convergence underway between the power generation and transmission & distribution sectors, driven by digitalization, decarbonization, decentralization and electrification. It inspires thought leadership, collaboration, and innovation to transform the future of electricity.

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