

One Operator's Innovation Journey

German plant operator Kraftwerke Mainz-Wiesbaden AG (KMW) is developing a steam reuse concept that will maintain the hot-start capability of its power plant at times when generation is not profitable, but a fast restart is desired. As part of numerous upgrades and updates to stay competitive, KMW says the steam reuse concept is a world first.

Text: Rhea Wessel Photos: Claudius Schulze





Thomas Zimmerer, KMW's Technical Service I&C Engineer, takes pride in the innovative heating concept.

“We’re pioneering the use of steam to keep plant components warm for hot starts whenever we want.”

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The Rhine River was once the northernmost frontier of the Roman Empire. Today, the mighty body of water transports freight, people, and ideas between the Alps and the North Sea. Along its winding path, the river flows through the industrial heart of the German city of Mainz, where on its banks a combined cycle power plant is trying something new. While other plant operators struggle in the market for fossil fuel power – facing lower demand, lower margins, and a harsh competitive climate due to subsidies for renewable energy – KMW is meeting the challenges with decisive steps to make its plant operations more flexible.

As part of those steps, KMW has tested a system that makes use of steam from a nearby waste burning facility to keep components in the power

plant warm so that the plant can be started up faster and more frequently. The system will allow KMW operators to respond quickly when demand for power rises and prices are adequate. Like a few operators elsewhere in the world, KMW already makes use of residual steam to generate electricity. The plant was designed with a larger than usual steam turbine and heat recovery steam generator, so KMW could use 65 tonnes of steam from the waste burning facility. The steam is transported to the electricity plant in an overland line that is more than 100 meters long.

Worldwide First: Warm Component Heat Reuse Concept

KMW's pilot project using the steam to keep components warm is the first to test the idea of using steam to enable a plant to keep hot-start conditions



Residual steam from this waste burning facility near the KMW plant will soon be used to maintain KMW's hot-start capability.

after overnight standstill, according to plant operators. Together with Siemens, KMW has validated the concept. The board is working on plans to improve the initial idea and install a system permanently. In addition, KMW has applied for a patent for the heating concept.

“We’re the first to pioneer using steam to keep plant components warm for hot starts whenever we want,” says Thomas Zimmerer, KMW's Technical Service I&C Engineer. “Over the past three years, we have defined the process and the mechanics of how and where to integrate steam. The next step is to run more tests and analyze results with our operations and business experts,” Zimmerer explains. For Zimmerer and KMW, the concept is more than a question of engineering. It's a matter of euros and cents. “We need to know how much energy will be necessary to keep the steam turbine and the heat recovery steam generator warm. Does it even make sense?” Zimmerer says. Meanwhile, KMW, which operates a 410-megawatt turnkey plant from Siemens, is implementing a suite of hardware and software improvements that are part of Siemens Flex-Power Services™. These include a Hot Start on the Fly

adaptation and process optimizations for instrumentation and controls for the plant's steam turbine. In addition, KMW is modernizing its software operating system by migrating to an advanced one. The Hot Start on the Fly concept allows a parallel start-up of the steam turbine with the gas turbine. To make it possible, KMW purchased an updated and enhanced version of the steam turbine master subgroup control (SGC), which will be implemented during 40 days of standstill. This period is needed for KMW and Siemens to migrate the plant's instrumentation and control system from the SPPA-T2000 to the newest SPPA-T3000 version. One benefit of the SGC enhancement will be to accelerate hot start-up time by 10 to 15 minutes, which will keep 5,000 to 8,000 cubic meters of gas from being burnt during low-efficiency, part-load operation of the gas turbine. These changes will be implemented in mid-2014, and they are part of a long line of investments and innovations that KMW has made over the years, says Zimmerer, who has been a driving force behind the new heat concept for frequent hot starts.

Midsized Company, Big-Sized Ideas

As a midsized company where employees often work their entire careers, KMW has a culture that is open to innovation, according to Olaf Thun, who leads KMW's Generation division. Thun began working at KMW right after graduating from university, starting as the assistant to the CEO. Zimmerer has been at KMW for 31 years. Thun notes: “Fast decisions and short decision paths are the most important part of our innovation culture.” Where larger companies might have entire departments working on different aspects of innovation and efficiency improvement – and hardly speaking with one another about their projects – KMW engineers frequently sit together in the lunchroom bouncing ideas off one another.

Indeed, the design of the newly built lunchroom gives employees a relaxing and aesthetic place to take their meals, away from the constant drone of rotating turbines. Over a meal, people talk informally about projects, without regard to hierarchy or protocol. It was in this type of setting in 2011 that Zimmerer and colleagues first began discussing the idea of using steam to keep components warm. KMW had heard about, but had not yet purchased Hot Start on the Fly from Siemens, and it began thinking about how to stay in hot-start mode for a longer time.

Zimmerer remembers: “Though Siemens has a different concept for keeping the heat recovery steam generator warm, they were very interested in our idea and our pilot program. We worked with Siemens to test our heat reuse concept.” Being able to extend the range of the Hot Start on the Fly will be even more important as KMW faces yet another change, Zimmerer notes. Over the next years, a contract that KMW has for purchasing gas will change so that prices are more in line with market prices. At that point, when KMW must pay higher gas prices, KMW expects to significantly reduce the number of operating hours and starts per year. “This situation motivated us to optimize ►



Operators keep watch in the KMW control room.



SGC optimization will accelerate hot start-up time by 10 to 15 minutes.



The steam reuse concept allows the KMW plant to stay in hot-start mode for a longer time.

warm and cold starts and to implement a faster start-up sequence. We are confident we can reach these targets by maintaining hot start-up capability for more than eight hours with our new heating concept,” explains Zimmerer.

Innovation in Times of Steep Competition

For Thun, constant innovations and adaptations to improve the plant’s flexibility and efficiency are not only a technical challenge. They’re a necessary part of keeping pace with power market changes in Germany. Indeed, says Thun, “Operational and start-up flexibility is something you have to invest in.” In Germany, as part of reforms to support renewables, wind and solar power producers were given a first right to feed electricity into the grid. When wind and solar generation fluctuates, conventional power plants must balance out the grid – the so-called residual load. “When we built Power Plant Number 3 here, no one would have ever imagined that the plant would not operate at full capacity. Or that it might be started on a daily basis. It was unimaginable,” says Thun. KMW is actively involved in industry associations and dialogs in and around the energy market in Germany. Like others, KMW is looking for a business environment and a policy framework that will allow the plant to cover its costs or make a profit through conventional electricity production. Thun says the CO₂ certificate system, which prices emissions, has harmed KMW’s business because current certificate costs are so low that coal-powered plants have an advantage. That said, KMW places high value on its innovation culture and the opportunity to cooperate with Siemens as a way to buck the market trends. “Since we’ve agreed with Siemens on how to share responsibility for tests conducted on our plant, we have made our plant available for various prototype tests,” Thun says.

Florian Roehr, the Product Manager at Siemens for Flex-Power Services™, explains: “KMW’s willingness to test new ideas and products on short notice makes it a particularly interesting partner.” For instance, just after the KMW plant was commissioned in 2000, KMW upgraded to an A(3) combustion chamber. In 2003, it installed a Hydraulic Clearance Optimization (HCO), which shifts the rotor towards flow direction to optimize turbine clearances during steady-state operations. It was the first HCO implemented by Siemens in the SGT5-4000F fleet. In the same year, KMW installed Turn Down and the Compressor Mass Flow Increase upgrade (also as the first Siemens customer), and, in 2004 and 2007, burner upgrades. Looking forward, Thun would like to see KMW build another 400-megawatt gas and steam plant and continue with its

role as an innovation leader and test center. For instance, Thun envisions more enhancements such as minimized on-site power through smaller pumps in the condensate system and the evacuation system, as well as a fast plant shutdown capability. But the market in Germany is changing so quickly that much of the business is unpredictable. Says Thun: “Since I never know what will happen after the next election, I think flexible operations are the best way to go.” ■

Rhea Wessel is an American freelance writer based near Frankfurt. She writes about finance and technology, and her work has appeared in *The New York Times* and the *Wall Street Journal*.



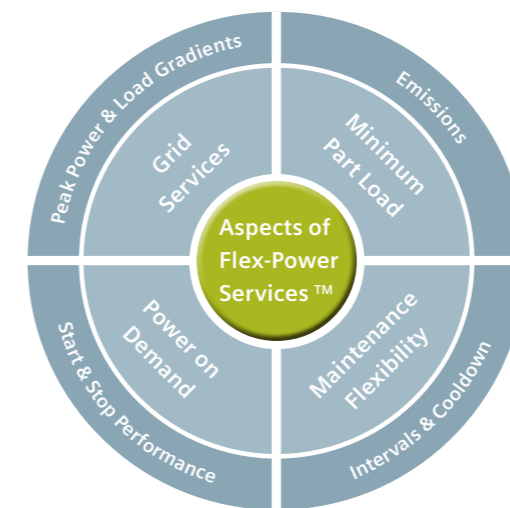
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Olaf Thun, Head of Generation division, KMW



Innovation: Faster Starts – How It Works

In response to new operating profiles with higher flexibility requirements for many fossil power plants, Siemens offers Flex-Power Services™, incorporating hard- and software solutions as well as studies and plant assessments.



KMW is improving fast-start capability by maintaining pressure and temperature in the steam generator with superheated steam from a nearby waste burning plant that enters the water-steam cycle of the CCPP. It will flow into the intermediate pressure system directly after shutdown, and later into the high-pressure system when the bypass station is opened. After 20 hours,

heat levels will be constant, with a temperature difference between flow in and flow out points in the intermediate pressure system. A convective heat transfer to the low-pressure system and the economizer is then created. The pressure in the low-pressure system will increase, allowing KMW to maintain the temperature and pressure in the system at the level required for fast starts on a regular basis.

KMW, which has received a patent for the heating concept, says the main benefits of its fast-start innovation will include:

- No hardware modifications necessary in the heat recovery steam generator and the water-steam cycle so far
- Steam consumption between 2 and 4 tonnes per hour
- Fuel savings at warm starts worth approximately €4,000
- Minimizing lifetime consumption of thick-walled components