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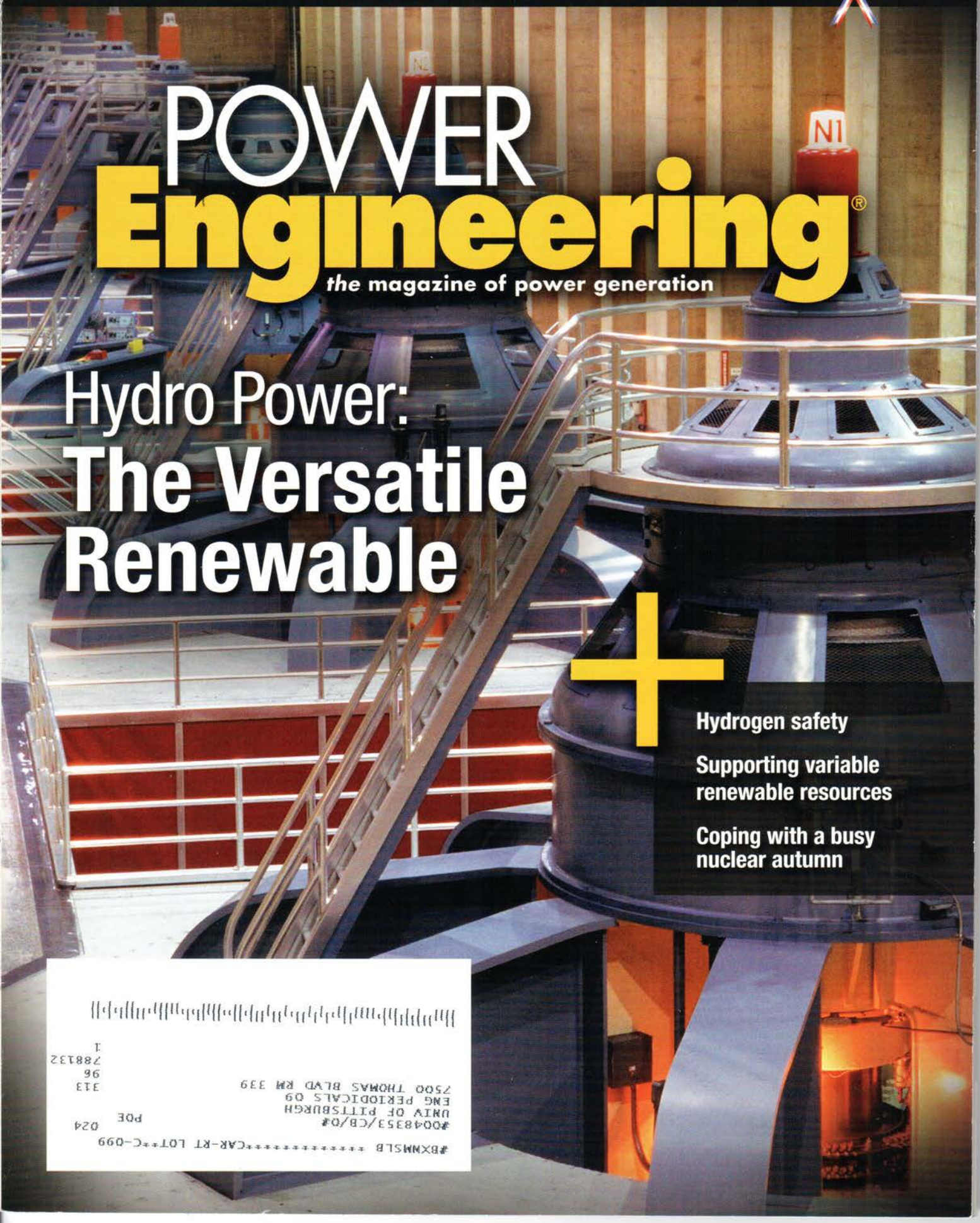

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A Variety of Hg Capture Solutions Are Available

By Steve Blankinship, Associate Editor

While vacating the Clean Air Mercury Rule (CAMR) has postponed implementation of mercury capture to some extent, improvements in ways to capture – and monitor – Hg have continued to wend their way through the pilot testing phases and into the commercial market.

Overall, all the coal plants in the United States emit about 50 tons of mercury per year. To place this into perspective, coal plants emit about a million tons of sulfur dioxide (SO_2) per year. CAMR was to ultimately reduce the 50 tons to 15 tons a year and Phase 1 was supposed to take effect January 1. But court challenges led to the vacating of the rule, thereby delaying indefinitely enforcement of the early phases of emission and monitoring compliance with federal rules. That didn't change the forward path of local rules adopted by close to two dozen states that elected to enact their own restrictions on mercury emissions from power plants and other industrial facilities.

"I'm not aware of any plants that complied with the former Clean Air Mercury Rule (CAMR) before it was vacated, but a number of plants have had to comply with state mandates," says George Offen, manager of air emission reduction programs and the beneficial use of coal combustion products for EPRI. There are about 20 states that have their own mercury rules."

The original CAMR concept espoused by EPA was for the initial reduction in Hg from coal-fired facilities to come largely as a co-benefit resulting from SO_2 and NO_x reduction measures required under CAIR Phase I, says Offen. "So almost everyone who was not under a state mandate to reduce mercury emissions was probably waiting for Phase II of CAMR. A few installed activated carbon Hg reduction systems, but we've been told that they aren't operating now unless under state rules. "

Monitoring mercury, essential in order to verify compliance with reduction rules, is a real challenge. Two things make monitoring difficult. Concentrations of mercury in most coals are extremely low. SO_2 is measured in parts per thousand. Uncontrolled SO_2 in the flue gas of a coal-fired boiler can be 1,000 to 4,000 parts per million, which today's emission control system reduce to 20 to 50 parts per million. Hg in coal flue gas is measured in parts per billion, and it's hard to measure such low quantities. In addition, the concentration of mercury varies greatly, further adding to the difficulty of obtaining a reliable percent reduction measurement.

"The monitors today are reasonably close to being commercial," said George Offen, manager of air emission reduction programs and the beneficial use of coal combustion products for EPRI. "A lot has happened in the past two years with monitoring." Reliability and consistency have improved and monitors also have a much lower failure rate. "The challenge we're facing is we don't yet have National Institute of Science and Testing (NIST) traceable calibration standards." Major manufacturers in the mercury monitoring sector include Tekran and Thermo Scientific.

The other difficulty with monitoring is that Hg readily reacts with ash and other materials such as chlorine. "But when measuring it for compliance you're only measuring vapor phase mercury and you have hardly any particulates so that helps some," said Offen. "On the other hand, you also have water, especially behind a scrubber."

Strategy

Mercury concentrations vary enormously in any given type of coal, so with the possible exception of Texas lignite (which has substantially higher mercury than other coals) the bands of mercury content overlap across coals. That means using existing selective catalytic reduction (SCR) and flue gas desulfurization (FGD) to make them capture Hg as well as other emissions. One way of enhancing Hg capture from FGD and SCR at power plants that cannot meet their mercury emission limits through co-benefits alone is to treat the coal (which typically for these situations lacks enough chlorine to force the mercury into a soluble compound) by adding something to it. Alstom's KNX process, for example, uses calcium bromide. Bromide can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers. Newly under consideration is the practice of injecting activated carbon upstream of the FGD to improve its mercury capture performance even more. Of course, a plant could increase its mercury capture rate, if needed, by using conventional activated carbon injection.

Power plants without an FGD would likely use sorbent injection, mostly an activated carbon, upstream of a particulate control device. The particulate control can be either the plant's existing device or a compact baghouse installed following the primary particulate control, with sorbent injection between the primary control and the new baghouse. Activated carbon and brominated activated carbon injection technology are being deployed at a number of power plants. Activated carbon is being offered by ADA-ES, Calgon, Norit, Sorbent Technologies and others. Although variations exist, "all of them revolve around some kind of activated carbon," said EPRI's Ramsay Chang, technical executive for emission controls.

ADA-ES, a leading surbent supplier, has began to build an activated carbon manufacturing plant in Red River Parish, Louisiana and plans to begin partial operation this summer and full operation this fall. The company has signed multi-year, off-take contracts to supply activated carbon to major utilities, with an aggregate value in excess of $160 million.

There are also variations of sorbent injection that provide ways to introduce activated carbon into flu gas. It can be injected in front of the air heater instead of behind it to provide more flue gas reaction time. There are also ways to agglomerate the carbon or grind it finer on site to achieve better mass transfer. These processes are also being offered commercially. The post

combustion Mer-Cure process Alstom offers is a combination of some of those methods.

Another type of sorbent injection, referred to by EPRI as alternative sorbents, are designed to be tolerant to higher temperatures making them more ash compatible. That means when the carbonate mixes with the ash it has less affect on the ash than normal activated carbon. Another group of non-carbon sorbents are known as amended silicane. "A lot of these are mineral-based non-carbons that show some promise but from our point of view are not yet consistent," said Chang.

For several years, Hitachi has offered its TRAC mercury capture enhancement solution. (See accompanying story beginning on page 50.)

Pre-Combustion and Post-Combustion

Alstom is attacking Hg from two different approaches that, in some cases, might be used simultaneously. Alstom's KNX pre-combustion offering applies calcium bromide to the coal prior to combustion to promote mercury oxidation. "If you can oxidize the mercury, you can collect it in downstream equipment," said Sean Black, director of Air Quality Control Systems and CO_2 marketing for Alstom. "It can be stand-alone to enhance the capabilities of the existing air quality control system or can be applied in combination with another mercury control technology such as our Mer-Cure post-combustion technology or activated carbon injection."

Halogens are known to improve mercury oxidation in the combustion area at higher temperatures as coal is being burned, and although chlorine or other halogens can be applied, Alstom found that bromine is the most effective halogen to use. In addition to being economical, it can be applied in concentrations where is enhances mercury oxidation without causing other concerns such as corrosion in the boiler. Calcium bromide is a commercially available solution in the marketplace.

Alstom's KNX business model is to offer the technology and let the customer supply the additive. "There is some equipment used to inject the solution," said Black, "but it's a fairly simple approach. It can be a capital solution or just a technology approach. "

"Mer-Cure is essentially an enhanced carbon injection system," said John Iovino, product manager for Alstom Power. "It has a silo, feed system and injection lances that inject the activated carbon into the duct work, similar to other systems on the market."

There are, however, two basic differences between Mer-Cure and other post-combustion activated carbon systems. Mer-Cure has an on line processor that keeps the resulting material from sticking together and de-agglomerates it to create smaller particle sizes and greater surface area. The second feature is the injection location of the sorbent upstream of the air heater. The benefits of upstream injection is that it's a higher temperature region with more internal duct area and provides more residence time for the sorbent to absorb the mercury.

Although Mer-Cure is targeted primarily to ESP configurations, Alstom has also installed it on wet scrubber applications where the combination of Mer-Cure and KNX worked well. "There are some instances where the KNX by itself provides the benefits and there are some cases where Mer-Cure alone can provide the desired benefits. There are many cases where the combination of the two work very effectively together," said Iovino. The KNX applied to the coal provides better oxidation of the mercury at a lower cost that brominated sorbents, allowing the Mer-Cure system further downstream to capture the mercury more efficiently."

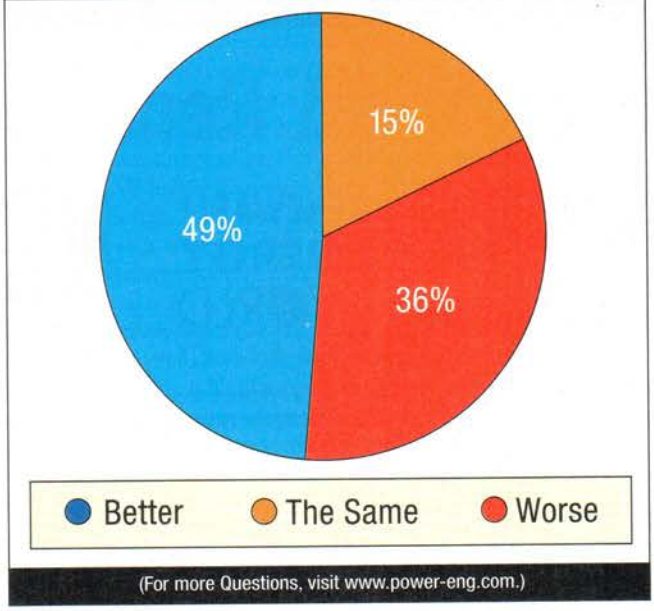
When a customer burns coal with high concentrations of elemental mercury emissions coming from the boiler, they don't get a lot of capture in the existing wet scrubber," said Black. "So we might see 20 to 30 percent mercury removal with the existing AQCS system. When they apply the KNX to the coal it goes from 20 to 30 percent removal to 80 to 90 percent. You may find other cases where they are burning a coal that is not sub-bituminous and you may already have a relatively high mercury removal of say 60 to 80 percent and we can enhance that even 90 percent removal."

Alstom says KNX is most attractive for a client burning sub-bituminous coal because those coals tend to have relatively low halogen content. Alstom has the exclusive license to market the technology in North America. Bromine can be injected in low concentrations to achieve the mercury removal needed without introducing significant halogens to the boiler. Using chlorine would achieve the same mercury removal but would increase corrosion including tube leaks. Lignite can be a good candidate for the process as well Bituminous offers a lesser value because of the relative degree of improvement is not as great. Bituminous is amenable to mercury capture to start with.

Iovino said the business model for Mer-Cure is a bit different from KNX. The customer purchases the rights to use KNX via a license agreement, whereas Mer-Cure is supplied as a complete system. Mer-Cure reduces sorbent usage about 50 percent compared to traditional activated carbon systems. As a result, significant O&M savings can be realized by dramatically reducing sorbent costs. By the end of this year Alstom expects to have 18 Mer-Cure systems installed and operational. pe

PE Online Question of the Week

Are the prospects for new nuclear power plants being built in the U.S. better or worse than they were a year ago?



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