

# A smarter way to remove slag

Most plants burning PRB coal use sootblowers, water lances, or both to remove slag from furnace walls and backpasses. But at many of those plants, cleaning operations may be inefficient shots in the dark, because it's not known where slag buildups are worse and need extra cleaning. A new approach to removing slag uses sensors to measure the weights of buildups by monitoring the increased stress they impose on a boiler's pendant support rods.

By Ken Wicker

**A**t coal-fired power plants, the buildup of slag and the use of sootblowing, water cleaning, or both techniques to remove it can be both costly and dangerous. Slag buildup on a boiler's walls and pendants creates many problems, including a loss in boiler efficiency and—potentially—damage to the bottom of the unit and danger to personnel from falling chunks of slag. Sootblowers and water lances have been known to damage boiler tubes if they haven't been aimed accurately and operated on an optimum schedule. Rather than fight the aftereffects of slag formation without knowing where it exists, it makes more sense to keep close tabs on slag formation.

Georgia Power Co. and Atlanta-based boiler cleaning specialist Clyde Bergemann Inc. have teamed up to fight slag at Plant Bowen in Cartersville (Figure 1). Rather than use cleaning chemicals (see page 59), Bergemann—and now Plant Bowen—rely on SmartGauge sensors installed on the leading side of the boiler's reheater pendant and economizer to detect the buildup of slag. The method uses as an indicator of slag buildup the increased stress it creates on

pendant support rods. Tests of the sensor system at Plant Bowen have shown this stress to be proportional to the increased slag weight on the boiler's tube section.

## Savvy sensors

According to Charlie Breeding, senior boiler engineer at Clyde Bergemann, the SmartGauges are installed on the rods connecting the boiler pendant's heat exchange surfaces to the steel frame at the top of the boiler house (Figure 2). These rods extend through the penthouse roof and are connected by pin joints to the building steel. The gauges are connected by cable to the side of the boiler, where a signal conditioner/amplifier

monitors their output—the additional strain or weight represented by slag buildup. This information is sent to the control room, where operators can use it to “see” where slag is forming and to reposition sootblowers and adjust their scheduling for optimum slag-removal efficiency.

The “smart” sensor system modernizes traditional sootblower operation by eliminating or curtailing the use of ineffective blowers and by indicating areas where additional blowing is required. Early tests showed, according to Breeding, “a dramatic reduction in the amount of steam used for sootblowing and a delay in the plugging up of the boiler. The system not only decreases the



**1. Plant Bowen.** Georgia Power's Plant Bowen in Cartersville has teamed up with Clyde Bergemann Inc. to fight slag with new sensors called SmartGauges. *Courtesy: Georgia Power Co.*



**2. Sensors.** SmartGauges installed on rods between the pendant heat exchange surfaces (left) detect increased weight from slag buildup. The amplifier cabinet (right) collects and conditions the sensors' signals and sends their data on to the control room. *Courtesy: Clyde Bergemann Inc.*

steam losses from sootblowing; it also enables a boiler to run longer between shutdowns.”

Bergemann’s smart-sensor technology was originally developed for and proven in the pulp and paper industry. Prototypes of the system were installed on six different heat-recovery boilers of a size equivalent to that of a 250-MW utility boiler. According to Andrew Jones, engineering fellow at International Paper, “Slag formation in these boilers is a particularly difficult problem because they burn black liquor, a byproduct of the paper-making process.” Black liquor has a high ash content and has been the source of serious slagging problems in the pulp and paper industry.

Success in these early tests encouraged Bergemann to adapt the technology for the power industry where slag—especially in boilers firing PRB coal—is an ever-present problem. According to Breeding, “The coal used in power plants has much less ash and different characteristics than black liquor.”

### Testing the system

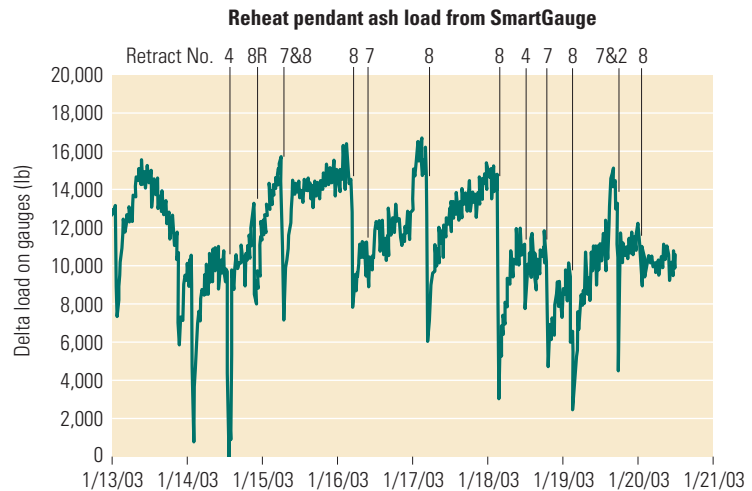
Georgia Power allowed Clyde Bergemann to install the smart sensor on a trial basis to measure slag accumulations on the reheat pendants of Plant Bowen’s Unit 4. That unit is powered by a supercritical, 880-MW Combustion Engineering boiler that burned Midwest coals for years after its erection in the 1970s. The mid-1990s saw the addition of separated overfire air (SOFA) and the use of different coals to reduce emissions. The steam blowers on Unit 4 are Copes Vulcan retractable blowers that extend 47 feet from each

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side of the unit. The economizer section is cleaned by Kokum Sonic 175-Hz sonic horns.

According to Chris Bentley, boiler engineer at Georgia Power, “The reheat pendant was chosen because it is located just above the nose arch and is an area known to be prone to slag formation.” On Unit 4, this pendant has a line of 16 rods holding up the front side of the

**3. SmartGauge results.** Georgia Power’s Plant Bowen was experiencing a steady buildup of reheater slag. Vertical lines indicate when sootblowing was initiated. Feedback from the SmartGauges (green lines) showed a dramatic decrease in strain on the reheater upon initiation of each sootblowing cycle. *Source: Clyde Bergemann Inc.*



pendant and a matching series of rods holding up the rear; each rod supports eight pendants. Of the 16 rods on the front, six were initially instrumented with the smart sensor gauges. Two gauges were also installed on the two rods at the front center of the economizer because this area was known to collect ash as well. Since the initial installation, all 16 of the reheater hanger rods have been fitted with the strain gauges, as were 16 of the 18 hanger rods across the front of the final superheater.

### Promising early results

Results of the trial at Plant Bowen showed a correlation between the operation of sootblowers and the weight of

built-up slag, as measured by the gauges. For example, during testing, technicians noted that readings increased when sootblowing events were skipped and that readings fell after steam blows. Using these results, technicians were able to relocate the sensor gauges to areas with the greatest slag buildup and adjust the scheduling of sootblowing for optimum cleaning effectiveness.

Figure 3 suggests how the system can be used to fine-tune sootblowing operation to keep boilers cleaner. For example, the data shown in the figure indicate which blowers are most effective at cleaning the reheater of Bowen Unit 4. If additional gauges were to be installed on other boiler sections, the entire fleet of sootblowers could be monitored for effectiveness and automatically operated as necessary.

Georgia Power and Clyde Bergemann plan to continue the study to determine which blowers have the most effect on deposit removal. It is hoped that additional data will lead to improvements in the sootblowing system’s cleaning effectiveness. “The goal,” according to Bentley, “is to determine which blowers are most effective. Those that are not effective will be used less frequently or not at all, and those that are effective will be blown more often.”

Bergemann also claims that there is a correlation between plant operational parameters (load, O<sub>2</sub> level, pulverizer performance, steam parameters, and so on) and slag deposit growth rates. According to Breeding, “In many boilers, deposits develop in the center, where gas temperatures are high. They can easily be detected with a full array of strain gauges.” By knowing more precisely where buildups are beginning to occur, a utility can adjust the operation of its sootblowing system to remove deposits before they become large enough to reduce a boiler’s steam temperatures and efficiency. ■