SMARTER BOILERS

Maximizing Your Boiler Performance to Enhance Your Bottom Line
SMARTER INNOVATION FOR THE POWER INDUSTRY

Four Critical Megatrends affecting the power industry:
Changing Demand
Resource Scarcity
Aging Plant Infrastructure
Increasing Regulations

Each of these factors contributes to enormous pressure on any company trying to maintain its profitability in these markets. The challenge is to meet current power demands without inefficiencies or costly outages.

Efficiencies
Your company’s teams are tasked with ensuring operations run smoothly. However, your company needs an innovative and effective way to maintain, and even improve, operational efficiencies, no matter what plant equipment infrastructure you currently have in place. With this in mind, Clyde Bergemann provides powerfully engineered innovative boiler cleaning and maintenance tools to help you master each of these challenges in a manner that is completely customized to your needs.

Clyde Industries customers realize an average yearly plant savings of $1.56 million and avoid 3 days of forced outages.
Optimize Performance
Clyde Industries’s offerings ensure precisely the right level of cleaning for optimizing your operations. In fact, in just one year, our customers can expect an average 25% cleaning media reduction in some cases as much as 75%.

Mitigate Risk
Clyde Industries serves customers in industries where the life cycle of a plant can be as much as 60 years– well beyond their intended life. Our boiler cleaning and maintenance tools ensure the safe operation and maintenance of their long life assets.

Maximize Profitability
With preventable boiler down time being one of the greatest causes of outages, it is no wonder customers turn to Clyde Industries for a full range of products to reduce boiler-incurred outages to almost zero – saving millions of dollars annually.

Manage Compliance
Staying ahead of compliance issues is easier with the Clyde Industries set of offerings, providing our customers an average yearly CO₂ emissions reduction of 1.88 tons/hour. The costs of compliance can be offset against the performance savings Clyde Industries provides.

The Clyde Industries Advantage
Clyde Industries is dedicated to improving boiler performance through innovative on-line boiler cleaning solutions for operators and manufacturers of boilers in the power generation, pulp and paper, industrial, and waste to energy markets. With over 20 years of unmatched expertise in over 800 boilers throughout North America, Clyde Industries has established a coveted reputation for helping its customers achieve millions of dollars in savings annually.
SMART ANSWERS FOR MITIGATING RISK

When boilers are unreliable the probability of outages, as well as millions of dollars in lost revenue put companies at great risk. Efficient, intelligent products from Clyde Industries address every area of boiler maintenance to ensure optimum operational performance throughout the life of the boiler.

BOILER RELIABILITY

<table>
<thead>
<tr>
<th>Problem</th>
<th>Derates/Load Shedding</th>
<th>Derates and load shedding can occur when the fouling inside the boiler becomes too problematic for the existing sootblower system to clean.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Answer</strong></td>
<td>In order to minimize, or even eliminate, the root cause for derating or load shedding, proper cleaning of the furnace is a must. SMART Cannons can increase the surface area cleaned of the furnace up to 80% of the total area, as opposed to the 30% typically cleaned by conventional wall blowers.</td>
</tr>
<tr>
<td>Problem</td>
<td>High Plant Heat Rate</td>
<td>Conventional sootblowing systems do not target the areas of the boiler where ash is building up, lowering heat transfer and boiler efficiency, and causing tube erosion from over cleaning.</td>
</tr>
<tr>
<td></td>
<td><strong>Answer</strong></td>
<td>SMART Clean™ technology can recognize where exactly in the boiler the deposits are in real time and can initiate the proper cleaning device based on where the build-up is occurring, when it is occurring, and with the proper cleaning intensity.</td>
</tr>
<tr>
<td>Problem</td>
<td>Tube Leaks</td>
<td>Tube leaks can be a major problem in a boiler, causing forced outages and lost revenue. These can be caused by either undercleaning of the tube banks, or overcleaning of the tube banks, both are results from an ineffective sootblowing system.</td>
</tr>
<tr>
<td></td>
<td><strong>Answer</strong></td>
<td>SMART Clean™ technology utilizes feedback from both our SMART Gauge system and on-line thermodynamic model to determine which sections of the convection pass have ash accumulations, thus reducing the number of blowing events on clean tubes. SMART Retracts can also be used to vary the intensity of individual cleaning events to provide just enough force to clean the ash, but not damage the tube.</td>
</tr>
</tbody>
</table>
**Problem**

**Clinkers**

Clinkers can form when ash builds up in the superheated tubes. Once excessive, it falls. This can cause significant damage to the bottom slope tubes, sometimes resulting in a forced outage.

**Answer**

Clinkers form with excessive furnace temperatures, and if the tubes are undercleaned. Using our SMART Cannon system, you can reduce and control your temperatures to within optimum limits, while our SMART Clean™ system keeps your superheated tube bundles clean using real time feedback from the SMART Gauges and ThermoDynamic Model to monitor ash build-up.
**Problem**

**High Spray Flows**
High attemperator spray flows are caused by excessive steam temperatures resulting from poor heat transfer in the furnace.

**Answer**
Our SMART Cannon system will reduce and control your FEGT to within design limits, allowing for proper heat transfer to occur in the superheat tube bundles. With proper heat transfer in the superheat section, the steam exiting the reheat section will be within design limits.

**Problem**

**Ineffective Boiler Cleaning Control System**
Troubleshooting and maintaining obsolete, outdated, and unreliable control systems requires a lot of time and technical expertise. In many cases "quick fixes" and “temporary patches” due to time constraints, parts availability, and high maintenance costs lead to greater unreliability and further costs and downtime making otherwise manageable operational issues unmanageable.

**Answer**
Our SMART Controls™ offers replacement packages and upgrades for all boiler cleaning equipment. Independent of the age, technology, or manufacturer a reliable control system can be provided to handle all your boiler cleaning requirements. State of the art technology, industry recognized components, and proven software ensure you are provided with the most reliable, modern, trouble free boiler cleaning control system on the market.
REDUCED BOILER EFFICIENCY

Inefficient boilers reduce output and revenue. With the implementation of SMART Clean™, SMART Furnace or SMART Convection™ products from Clyde Industries, most plants can see immediate benefits such as a 0.5% to 1% heat rate improvement annually – worth as much as $1M for a typical power boiler alone. These efficiency improvements flow directly to a company’s bottom line.

**Problem**

**Fuel Switch**
Changes in fuel source or blend will cause the fouling characteristics and locations to change, causing problems if the sootblowing system is based on a fixed or static cleaning cycle.

**Answer**

SMART Clean™ can dynamically identify the new fouling locations and decide which cleaning devices and intensity to use to keep the boiler flue gas and steam temperatures on target. SMART Cannons increase the cleaning coverage and remove tenacious deposits from the furnace effectively for all types of coals.

**Problem**

**Outdated Sootblowing System**
Conventional sootblowing systems are based on timers or operator experience to initiate cleaning events. This leads to ineffective sootblowing that does not target the areas of the boiler where ash is building up, therefore lowering heat transfer and boiler efficiency, as well as tube erosion from over-cleaning tube banks.

**Answer**

The SMART Clean™ closed-loop process transforms your sootblowing system into an automatic, demand-driven, targeted boiler cleaning system that positively affects your boiler efficiency, while eliminating tube leaks, clinkers and other problematic issues.

**Problem**

**Poor Heat Transfer**
Deposits on tube surfaces act as insulators and as such, reduce the heat transfer from the flue gas to the steam leading to multiple problems such as high plant heat rate.

**Answer**

SMART Clean™ offers measurement devices located strategically throughout the boiler to monitor heat transfer in real time to identify areas in which ash build-up is degrading the heat transfer.
EMISSIONS COMPLIANCE

Problem
High CO₂ Emissions
The level of CO₂ that can be released from a given coal-fired power plant depends on the type of coal burned, the overall efficiency of the process, and the use of air pollution control devices. Of these, the most cost effective is to increase the efficiency of your boiler.

Answer
SMART Clean™ can increase efficiency of a boiler by 0.5% to 1%, reducing CO₂ emissions by about 78,000 tons/year, and lowering fuel costs in the process.

Problem
Lost Efficiency Due To Air Pollution Control Technologies
Dry sorbent injection and fabric filters used to reduce acid gas and particulate matter emissions increase the amount of fan power needed to overcome their pressure drops, acting as a parasitic load on the plant, reducing profits.

Answer
SMART Clean™ can increase the efficiency of a boiler by 0.5% to 1%, virtually regaining all the lost output from installing systems such as dry sorbent injection and fabric filters.
The utility industry is among the country’s most capital-intensive sectors, with many of its costs stemming directly from investments in and maintenance of the power plants and structures that are used to deliver electricity. Utilities typically cannot recover their costs when they are incurred; instead, they are required by regulatory authorities to spread out their costs to customers over the physical life of the investment—sometimes as long as 30 years—under the assumption that there will be a stable customer base. This means that one of the best profit maximizing actions utilities can take is to lower their operational costs wherever possible.

**HIGH OPERATIONAL COSTS**

**Problem**

**Sootblower Maintenance**
Conventional and older sootblower systems can run too frequently, leading to higher maintenance requirements, wasting tens of thousands of dollars a year on unnecessary repairs.

**Answer**
Clyde Industries sootblowers are designed with the severe conditions of a power boiler in mind, giving owners the lowest cost of ownership available, with the best warranty on the market. Due to the galvanized housing, we can offer a lifetime warranty on all our retracts, saving plants an average of $8,000 per sootblower over its lifetime compared to competitors sootblowers. Our rugged design also saves plants $1,000 to $2,000 each year in lower maintenance and spare parts costs.

**Problem**

**High Cleaning Media Costs**
On-line boiler cleaning based on a fixed interval can be inefficient, leading to high cleaning media usage and wasted money. Because blowing media is not free, plants can save significant money by reducing the usage.

**Answer**
Clyde Industries offers the most efficient sootblower nozzles available. Proven in the field and laboratory tests, our CFEIII nozzle can deliver the most power with lower flow rate and pressures than any other nozzle on the market. Combined with our SMART Clean™, cleaning is only activated when and where it is truly needed, reducing the number of cleaning events per day.
Problem: The problems that occur over time in power, pulp and paper plant boiler systems are not unique. Sooner or later a plant will begin to experience issues in the areas of boiler reliability and reduced efficiency, emissions compliance and high operational costs.

Customized Solution: Clyde Industries’s SMART solutions are designed to specifically address these four key areas of concern, with the adaptability to deliver remarkable operational improvements, regardless of the age of the equipment, or existing processes already in place.

Efficiencies & Savings: Clyde Industries’s results speak for themselves, time after time, with improved operations and boiler function that translates directly to the bottom line.

### Boiler Reliability

<table>
<thead>
<tr>
<th>Boiler</th>
<th>Problem</th>
<th>Solution</th>
<th>Result</th>
<th>Yearly Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>390 MW B&amp;W Sub Critical Lignite</td>
<td>Clinker related forced outages</td>
<td>SMART Convection</td>
<td>“38% reduction in retractable operations (70 operations less / day)”</td>
<td>&gt; $430,000</td>
</tr>
<tr>
<td>800 MW CE Super Critical Sub-bituminous</td>
<td>Reliability issues and tube damage</td>
<td>SMART Convection</td>
<td>10º-15ºF Improvement in EEGT, 0.3% heat rate improvement</td>
<td>&gt; $3,900,000</td>
</tr>
<tr>
<td>680 MW CE Sub Critical PRB</td>
<td>Clinker related forced outages and performance issues</td>
<td>SMART Convection</td>
<td>18% reduction in retractable operations (40 operations less / day), 0.5% Heat Rate Improvement</td>
<td>&gt; $1,770,000</td>
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</tbody>
</table>
## Reduced Boiler Efficiency

<table>
<thead>
<tr>
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<th>Solution</th>
<th>Result</th>
<th>Yearly Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 MW B&amp;W Super Critical PRB</td>
<td>Performance Issues</td>
<td>SMART Convection, SMART Furnace</td>
<td>Eliminated steam consumption of 48 wallblowers, 0.4% Heat Rate Improvement</td>
<td>&gt; $570,000</td>
</tr>
<tr>
<td>350 MW CE Super Critical Lignite</td>
<td>Performance Issues</td>
<td>SMART Convection, SMART Furnace</td>
<td>0.12%-0.14% Heat Rate Improvement</td>
<td>&gt;$250,000</td>
</tr>
</tbody>
</table>

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<tr>
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</thead>
<tbody>
<tr>
<td>800 MW FW Sub Critical Bituminous</td>
<td>SCR Temp Control and Fuel Switch</td>
<td>SMART Convection</td>
<td>15% reduction in retractable operations (35 operations less /day), SCR Flue gas temp controlled below target 760°F at 99% of the time for all fuel blends, 1% Heat Rate Improvement</td>
<td>&gt; $750,000</td>
</tr>
<tr>
<td>1350 MW B&amp;W Sub Critical PRB</td>
<td>Performance Issues and Fuel Switch</td>
<td>SMART Furnace</td>
<td>Eliminated steam consumption of 118 wallblowers, 0.15%-0.17% Heat Rate Improvement</td>
<td>&gt; $2,480,000</td>
</tr>
</tbody>
</table>

## High Operational Costs

<table>
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<th>Yearly Savings</th>
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<tbody>
<tr>
<td>868 MW Super Critical CE PRB</td>
<td>Performance Issues and Fuel Switch</td>
<td>SMART Convection, SMART Furnace</td>
<td>“Eliminated 4 days of forced outages out of the year, Eliminated 20MW Fixed Derate, Reduced Air Consumption for 47% in retractable operations (115 operations less /day) and eliminated steam consumption of 60 wallblowers”</td>
<td>&gt;$9,360,000</td>
</tr>
</tbody>
</table>
To learn more, contact Clyde Industries Sales at 770-557-3600 or email info@clyde-industries.com.