

Process Recovery Boilers

Reliable and efficient steam production
for the pulp and paper industry



RENEWABLE | ENVIRONMENTAL | THERMAL

Since 1929, when The Babcock & Wilcox Company (B&W) developed the world's first Kraft recovery boiler with G.H. Tomlinson, our recovery boiler design has evolved with many new features and customer benefits. Our recovery boilers offer high availability with safe operation and low maintenance.

Proven experience to meet the energy requirements of today's pulp and paper mills



B&W's recovery boilers provide owners and operators with increased efficiency, reliability and flexible operation that lowers your overall boiler lifecycle cost.

B&W PR boiler design benefits:

- Increased efficiency
- High availability
- Improved safety
- Low emissions (CO, NO_x, SO₂ and VOC particulate)
- High solids firing for optimized thermal efficiency
- Advanced steam drum internals and riser/supply systems for circulation safety margin
- Reduced construction costs and greater schedule certainty with modularized design
- Overall lower boiler lifecycle cost

The latest process recovery (PR) boiler design from Babcock & Wilcox (B&W) is the leading-edge technology in the industry.

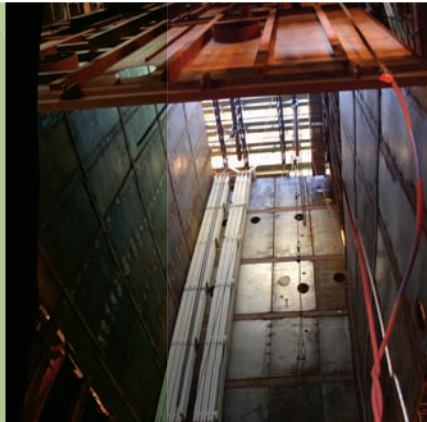
With the largest installed base in the world of more than 350 recovery boilers, B&W is committed to the pulp and paper industry by helping today's energy-intensive mills become more competitive and profitable.

Our recovery boiler customers benefit from B&W's industry leadership in utility boiler design. We can apply utility boiler technology advancements such as high-temperature/pressure designs, advanced materials, and reheat steam cycles to PR boilers whenever it is appropriate, assuring you of the most up-to-date design for your plant.

Largest Installed Base of Recovery Boilers in the World

Lowering the total cost of ownership

B&W's recovery boiler design includes features that lower the total cost of ownership with high availability, increased efficiency and reduced maintenance.



Reduced Construction Costs

B&W's longflow economizers (shown here) and generating banks provide effective heat transfer and are modularized for easy installation, reducing construction costs.

High-Temperature Superheater

The boiler's high-temperature superheater metallurgy and modular heating surface provide a flexible design for initial and future mill operating conditions. Because the primary superheater is located downstream of the furnace cavity with steam flowing parallel to the flue gas, the coolest available steam will be exposed to the hottest gas and radiant heat from the furnace. This arrangement provides effective heat transfer and minimizes tube metal temperatures, thereby reducing tube metal corrosion and improving reliability and safety.

Modularized Longflow Economizers and Generating Bank

B&W's longflow economizers and generating bank sections are shop-modularized for lower installation cost. They incorporate the latest design and technological improvements available for recovery boilers. B&W's robust design features have been selected as the basis for current industry standards.

Longflow economizer

- Two-gas/two-water pass arrangement provides effective heat transfer from the counter flow of gases across the tubes.
- Bottle headers serve as integrally designed lifting devices, eliminating expensive rigging beams or sleds.
- Tapered fin design significantly reduces tube stresses and tube leaks, compared with the experience of other angled finned designs.

Longflow generating bank

- Shop-assembled tube sections are modularized to minimize construction time and expenses.
- Full-length access cavity accommodates retractable sootblowers for optimal cleaning and maintenance.

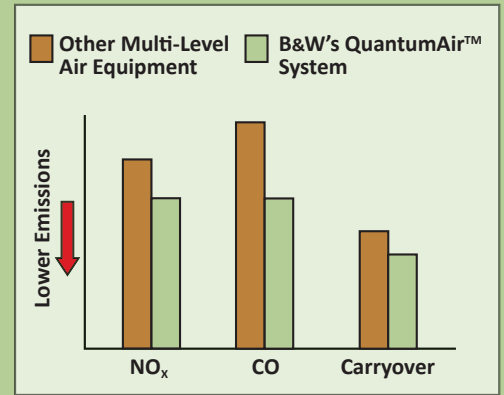
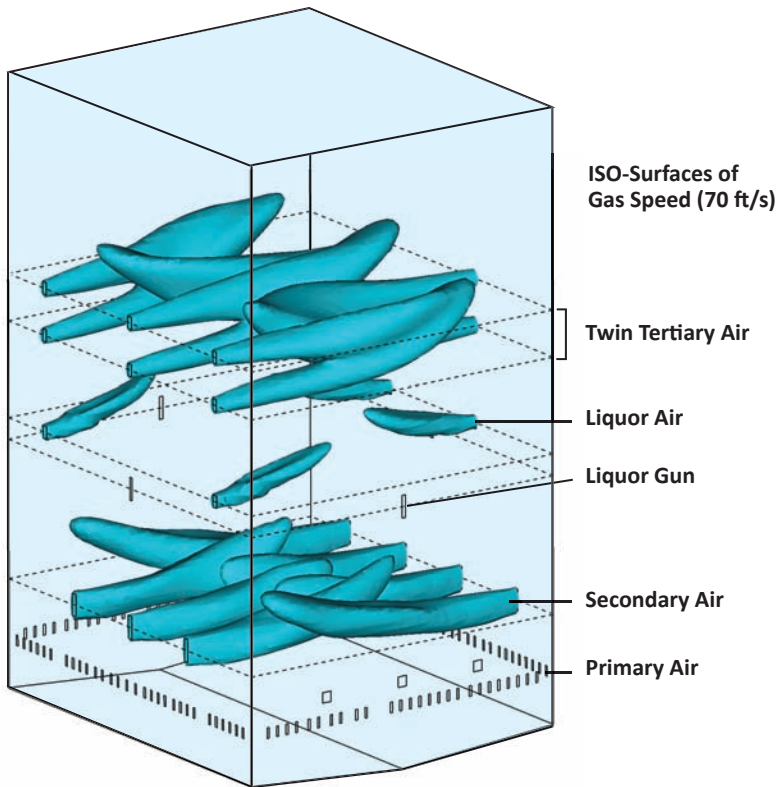
Advanced Circulation Design

For personnel safety, one of the most critical recovery boiler component designs is the natural circulation system. Due to the potential for smelt water reactions and the corrosive lower furnace environment, recovery boilers require ample

circulation design margin for normal and upset mill conditions. B&W provides circulation margin in the design phase using COMO, our proprietary computer modeling system. Our patented low pressure drop internals, and B&W specified multi-lead ribbed tubes are key components that add safety margin. B&W is routinely called upon by both industrial and utility customers to analyze and fix issues on non-B&W boilers.

Modern, Single-Drum Design

Drum internals provide high steam purity to meet today's steam turbine requirements, with a low pressure drop for additional circulation safety margin. B&W's welded, single-drum design addresses the need for high pressure and temperature steam cycles with a large, conservatively sized furnace. The location in front of the furnace provides other benefits such as extended drum length and simpler erection.



B&W's QuantumAir system outperforms other multi-level air systems in reducing NO_x, CO and carryover.

The QuantumAir system was developed by utilizing B&W's COMO fluid dynamic modeling program that enabled designers to optimize the quantity and location of air levels for the most efficient combustion.

Leading the industry with technology innovations

COMO Modeling Program

B&W's industry-leading combustion modeling (COMO) program for black liquor combustion has led to numerous air system enhancements and modifications for improved boiler efficiency and emissions. B&W leads the industry with state-of-the-art designs, equipment options and optimized operating conditions for your recovery boiler. Our proprietary COMO system has become the benchmark for other industry models.

QuantumAir™ System

B&W's QuantumAir system – developed based on our industry experience and combustion modeling program for black liquor combustion – sufficiently lowers nitrogen oxides (NO_x), carbon monoxide (CO) and carryover to help reduce boiler emissions. The multi-level air system uses levels of primary and secondary air in conjunction with close-coupled liquor air and twin tertiary air. The system provides reduced emissions through increased staging and higher air level elevations.

B&W's QuantumAir system can be adapted for **firing up to 85% black liquor solids**.

QuantumAir system benefits include:

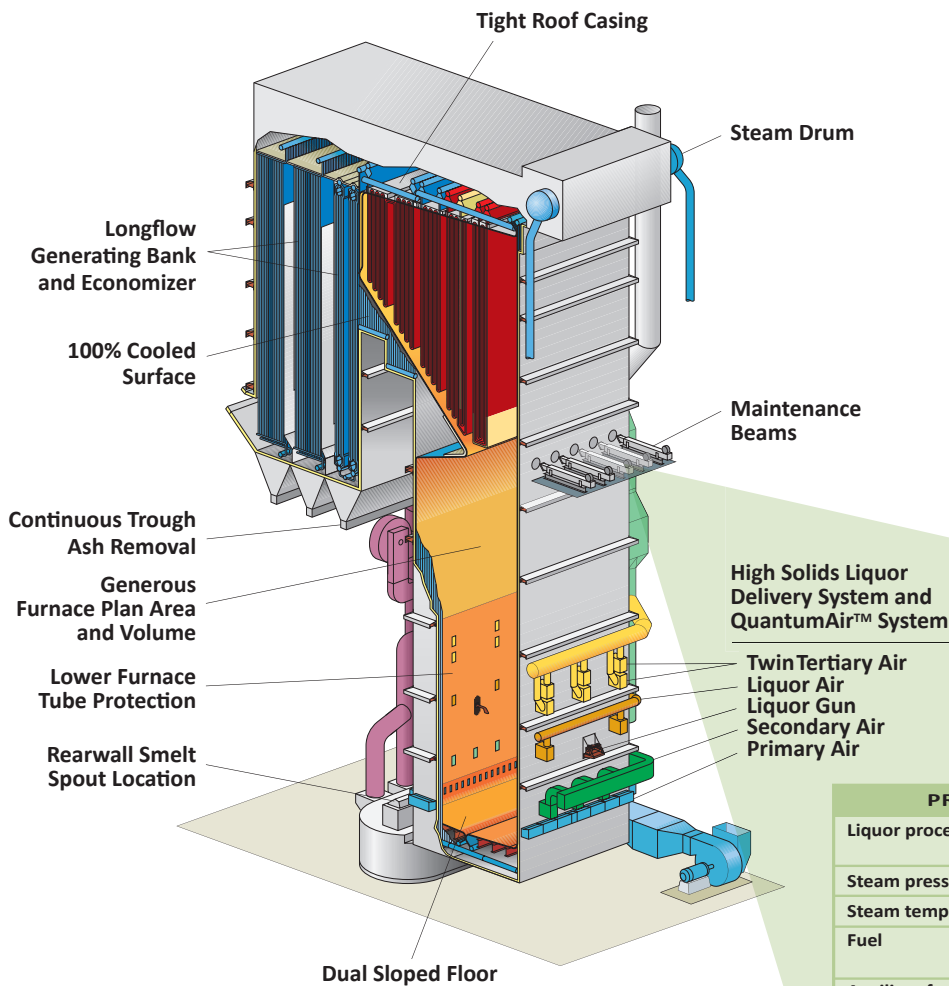
- Increased staging reduces NO_x emissions.
- Reverse interlaced secondary air ports minimize gas plume along the furnace rear wall providing lower CO emissions and reduced maintenance.
- Single-level secondary air provides excellent control of char bed combustion for both low and high solids firing, which minimizes operational

upsets and auxiliary natural gas fuel consumption.

- Liquor air level reduces fine particle carryover above the liquor guns.
- Twin tertiary air level ports aligned with the liquor level ports further reduce particle carryover, improve mixing and reduce emissions, enabling you to extend the run time between water washes.

Improved Boiler Efficiency

Many features and capabilities of our process recovery boilers provide



**Safety
Reliability
Lower Emissions**

PROCESS RECOVERY (PR) BOILER	
Liquor processing capacity	up to or greater than 10,000,000 lb/day (4500 t/day) dry solids
Steam pressure	to 1850 psi (12.6 MPa)
Steam temperature	to 950F (510C)
Fuel	pulp mill liquor, soda, Kraft and other fuels
Auxiliary fuels	natural gas and/or oil
Solids firing	Up to 85% black liquor solids

improved boiler efficiency:

- Lower exit gas temperatures
- Increased air temperatures
- Higher steam temperatures and pressures
- Reheat steam cycles
- High solids firing

Customized Liquor Delivery System

For optimal combustion, reduced emissions and improved long-term maintenance, B&W offers a customized liquor delivery system that optimizes liquor spray patterns, droplet size and distribution into the furnace. The liquor burner system can be applied to match the specific solids content and fluid properties of your liquor.

Lower Furnace Protection

Based on your recovery boiler design requirements and project economics,

B&W designs and manufactures an array of recovery boiler lower furnaces with metallurgy that includes:

- composite tubes
- weld overlay tubes
- chromized and carbon steel pin studs

High alloy composite furnace panels are manufactured in B&W's nuclear-grade manufacturing plant to provide a high-quality product for this critical component. Our automated pin studding machine provides a high-quality, consistent pin stud pattern reducing plant maintenance, forced outages and maintenance outage durations.

Safety and Reliability Through Improved Technology

The safe operation of B&W's recovery boilers has always been a

priority. Specific examples include:

- Explosion relief point is located in upper furnace, away from operating floors and personnel for improved safety.
- Increased number of floor beams provides greater support.
- Flexible seals and attachments minimize stress-assisted corrosion and reduce maintenance.

Auxiliary Fuel System – LM2100™ Retractable Burner

B&W's innovative LM2100 auxiliary burner is designed for improved reliability, safety and maintenance. The burner and lighter elements retract when not in the firing position, which significantly improves cleanliness and reduces heat damage to the burner tip.

Complete product lifecycle support

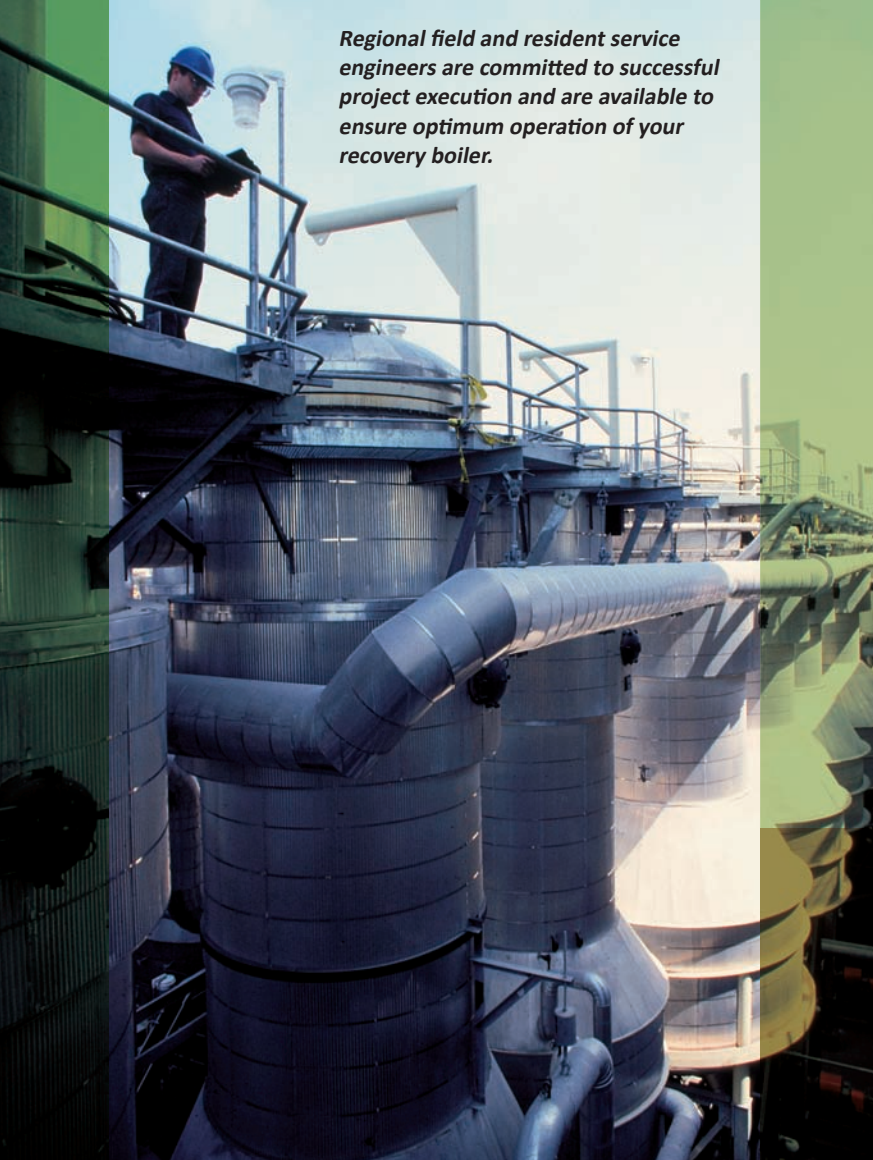
Safety, reliability and ease of maintenance are the standards of all B&W recovery boilers.



B&W is committed to providing proven technology and reliable long-term operation for your recovery boiler. From project design and execution to complete aftermarket products and services, we are your single source for the entire lifecycle of your recovery boiler. B&W's total package provides you with proven recovery boiler technology and service by integrating:

- reliable field engineering services
- construction and maintenance
 - quality worldwide manufacturing
 - global sourcing with experienced project execution

Full-Service Capability



Regional field and resident service engineers are committed to successful project execution and are available to ensure optimum operation of your recovery boiler.



B&W continues to make investments in its worldwide manufacturing facilities as well as its extensive network of suppliers to ensure high-quality boiler components are delivered on time.



Worldwide Manufacturing

Through comprehensive supply chain management, worldwide sourcing, and alliances with domestic and international fabricators, you can depend on quality materials, on-time delivery and reduced total cost. B&W's commitment to quality products and services is also demonstrated by our continuous capital investments at our manufacturing facilities around the world.

Equipment Upgrades

Some existing process recovery boilers can be upgraded to incorporate the latest design technologies which provide many operational

benefits. B&W has the experience needed to completely analyze the available options and recommend the most cost-effective solutions for improved safety and efficiency.

Upgrade options to both B&W and non-B&W recovery boilers include:

- Capacity increases
- Superheater upgrades to maintain steam temperature
- Economizer replacements to improve boiler efficiency
- QuantumAir™ system upgrades for lower emissions and improved cleanability
- LM2100™ auxiliary burner retrofits
- Low odor conversions

Field Engineering Services

B&W's field service engineers are available to provide expert and timely technical support. Our experienced field and resident engineers can advise and consult on the operation, maintenance and upgrade of your boiler equipment, regardless of the manufacturer.

A small sample of our field engineering services includes:

- Preventive maintenance
- Outage planning
- Boiler condition assessment
- Life extension
- Nondestructive testing programs and troubleshooting



**Choose B&W for Long-Term Reliability
and Lower Total Cost of Ownership**

B&W is committed to delivering new technologies to meet the steam generation demands of today's pulp and paper industry. From design engineering, manufacturing and construction to startup and field service, B&W provides integrated solutions to maximize the efficiency and dependability of your recovery boiler.

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Established in 1867, Babcock & Wilcox is a global leader in renewable, environmental and thermal technologies and services for power and industrial applications.

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