Based on the study findings, Jansen recommended that the existing overfire air (OFA) delivery system be replaced with modern high capacity OFA systems. The old OFA system was designed in the mid-1980s and has been continually operating since then. The most recent upgrade to the system was a few years ago. This Riley Stoker unit had been converted to burn RDF on a traveling grate in 1989 and has a design capacity of about 150,000 lb/hr of steam.

The performance of the OFA delivery system had been a significant issue in recent years. The OFA system was designed for a combustion air capacity of 5,000,000 ft³/hr, but the actual combustion air capacity is closer to 2,000,000 ft³/hr. This reduces the amount of mixing air available to control the combustion, which leads to increased CO emissions, reduced NOx emissions, and reduced steam production. It has also been observed that the OFA system is not able to control the combustion in some cases.

In response to the performance issues, Jansen recommended an upgrade to the OFA delivery system. The recommended upgrade includes the following:

- Replacement of the old OFA system with a modern, high capacity OFA system
- Installation of a new OFA control system
- Realignment of the OFA nozzles

Jansen was first contracted in the summer of 2010 to conduct a Phase I engineering study on the OFA system. The study was to determine the extent of the problems and to recommend a solution.

In the summer of 2011, Jansen was contracted to perform a Phase II engineering study on the OFA system. The study was to design and specify the new OFA delivery system and to perform a detailed cost analysis of the proposed solution.

The Phase II engineering study was completed in the fall of 2011. The new OFA system was designed to meet the following performance goals:

- Increased combustion air capacity: 5,000,000 ft³/hr
- Reduced CO emissions
- Increased NOx emissions
- Increased steam production

The new OFA system was installed in the fall of 2011 and has been operating since then. The performance of the new OFA system has been excellent, and the facility has experienced a significant reduction in CO emissions. The facility has also experienced an increase in NOx emissions, which is expected due to the increased combustion air capacity.

The new OFA system has also been incorporated into the facility's emissions management system. The system was designed to be fully integrated with the facility's emissions monitoring system and to provide real-time data on the emissions performance of the facility.

In conclusion, the upgrade to the OFA delivery system has been a significant improvement for the facility. The new OFA system has provided a significant reduction in CO emissions and an increase in NOx emissions, which is expected due to the increased combustion air capacity. The facility has also experienced a significant increase in steam production, which is expected due to the increased combustion air capacity. The facility is now able to meet the performance requirements of the facility's emissions management system and to provide real-time data on the emissions performance of the facility.
Jansen Conference Presentations and Technical Papers

This past year, Jansen personnel have made several technical presentations at national and international conferences and meetings. These presentations were:

- **CO Emissions: Combustion Enhancements to Meet Boiler MACT Limits in Biomass-Fired Boilers**: presented by John La Fond at the Boiler MACT Control Technology Workshops during NACAA’s Southern and West Coast Regional Meetings, respectively on June 30 in Charleston, South Carolina, and on September 30 in Vancouver, Washington.

- The presentation focuses on controlling CO emissions from wood-fired boilers in the pulp and paper and wood products industries in preparation to meeting the newly published Boiler MACT limits for CO.

- **Biomass Combustion Principles and Boiler Optimization**: presented by Arie Verloop at the 2011 Electric Power Conference, May 10-12, Chicago, IL.

- This presentation discusses the fundamentals of CO formation and destruction, review the various proposed Boiler MACT, Boiler CACT, and CISWI-CO targets, provide examples of CO emissions in typical biomass boilers, review ways to lower CO emissions, discuss the impact of lowering CO on other pollutant emissions (PM and NOx), and provide a recommended “engineered” approach to CO emission reduction projects.

If you have an interest in receiving an electronic copy of one or more of these papers or have a specific inquiry, please contact the authors Steve Walsh (425.952.2825) or John La Fond (425.952.2835) or e-mail at stwalsh@jansenboiler.com.

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Jansen at Pacific West Biomass Conference & Trade Show

Jansen’s booth at the Pacific West Biomass Conference & Trade Show, held January 10-12, 2011 in Seattle, was well-visited by friends and people with an interest in our work and making inquires about our capabilities and experience. The photo shows Jansen’s Steve Campbell (l) and Chris Dayton (r) talking to someone who is doing just that! Jansen will also have a booth at the upcoming NWTEC 19 Waste-to-Energy Conference in Lancaster, PA, May 16-18, 2011. Come visit!
The paper discusses options for boiler modifications with the purpose to:

- Biomass Combustion Principles and Boiler Optimization;
- Biomass Boiler Optimization to Meet Proposed Boiler MACT CO limits in Biomass-Fired Boilers;
- Chemical recovery and biomass boiler evaluations to meet power generation upgrades.

Over the last year, Jansen has been assisting many clients that burn biomass fuels with Boiler MACT assessments to help identify the boiler and pollution control equipment upgrades necessary to meet the proposed limits, along with budget cost estimates. With an estimated more than 200,000 boilers operating in industrial, commercial and institutional facilities, studying, planning and responding to all the required upgrades will be extremely challenging in the time allotted. The shifting permit limit targets have caused uncertainty across the industry and needed boiler maintenance and upgrades for efficiency and capacity purposes have been postponed until the Boiler MACT rules were finalized.

Jansen will continue to assist biomass-fired boiler owners/operators with determining how the Boiler MACT regulations will impact their operations and provide solutions for units that would exceed the new limits.

How Can Jansen Help?

Jansen assists boiler owners/operators to determine how Boiler MACT (or CSSVR) regulations impact their boiler and provide an evaluation of the boiler’s combustion characteristics. If operational improvements are not sufficient to meet the emission requirements, Jansen can provide process upgrades and team with pollution control equipment providers to help comply with the new regulations.

For further information and specific inquiries, please call John LaFeud at 425.952.2832 or Arie Verloop at 425.952.2825 or by e-mail at andrea.striz@jansenboiler.com.

**NEWS Briefs**

Since our last newsletter (No. 37, Spring 2010), Jansen has conducted the following process and design engineering projects in the Forest Products, Independent Power Producers, Energy-from-Waste, and other industries (many are in progress):

- Combustion system upgrades for biomass boilers.
- Combustion system upgrades for RDF-fueled boilers.
- Superheater and economizer upgrades and/or new supply.
- Biomass and RDF boilers engineering evaluations.
- Chemical recovery boiler performance evaluations and capacity studies.
- Chemical recovery and biomass boiler evaluations to meet power generation upgrades.
- Supply of injection matrix for DHC: disposal in biomass boilers.
- Boiler circulation studies and UFM data collection.
- CFD modeling of biomass, chemical recovery, MSW, and RDF-fueled boilers.
- Boiler operational fine-tuning and optimization support.
- Boiler MACT and CSSVR compliance review.

This work was conducted, or is currently in progress for the following companies:

- Audita Utilities
- Brunswick Cellulose Inc.
- BPG Siroco s.a.
- Canadian Pulp & Paper Company
- Confor
- Catalyst Papers
- Clearwater Paper
- Covanta Energy
- Domtar Inc.
- Energym Packaging
- Georgia-Pacific LLC
- Great River Energy
- International Paper Company
- Kimberly-Clark
- Longview Fibre
- Louisiana-Pacific Corporation
- MeadWestco
- Minnesota Power
- Monde SIC
- NewPage Corporation
- Orange County Container Group
- Packaging Corporation of America
- Port Townsend Paper Corporation
- Rayonier Performance Fibers LLC
- RenewEnergy Holdings LLC
- Renshaw Energy Midwest Co.
- Roto/Serr
- SAPP North America
- Smurfit-Stone Container Corporation
- Sunoco Products Co.
- SW Newprint Co.
- Thermal Power Plant Zvulun
- Tobi Industries
- Wheelabrator Technologies, Inc.
- Wheelabrator Technology Company

For further information on these types of projects, please contact Arie Verloop at 425.952.2825 or by e-mail at andrea.striz@jansenboiler.com. Additional information and specific project references can be found on our website at www.jansenboiler.com.
Jansen Conference

Presentations and Technical Papers

This year, Jansen personnel have made several technical presentations at national and international conferences and meetings. These presentations were:

- **CO Emissions: Combustion Enhancements to Meet Boiler MACT Limits** by John La Fond at the Boiler MACT Control Technology Workshops during NCASI’s Southern and West Coast Regional Meetings, respectively on June 30 in Charleston, South Carolina, and on September 30 in Vancouver, Washington.

- The presentation focuses on controlling CO emissions from wood-fired boilers in the pulp and paper and wood products industries in preparation to meeting the newly published Boiler MACT standard for CO.

- **Boiler Combustion Principles and Boiler Optimization** by Arie Verloop at the annual SAPPF Kraft Recovery Conference, January 15-16, St. Petersburg, Florida.

- The paper presents an overview of solid biomass combustion in grate-fired combustors. The combustion process is described from fundamentals, parameters of emission control technology, and problems related with state (including modeling), through providing upgrade elements and typical benefits to improve operational performance in the area of grate combustion.

- **Boiler Upgrades to Increase In-House Power Generation** by Arie Verloop at the Western Regional Boiler Association (WRAA) annual meeting in Eugene, Oregon, March 15-17, 2011.

- The paper discusses options for boiler modifications with the purpose to increase the electrical power generation in biomass fueled steam boilers by changing steam temperature, operating pressure, and boiler steam rate.

- **A Improved Method for Modeling NOx Emissions from Biomass Combustion** by Dr. Allan Walsh at the 9th European Conference on Industrial Combustion, 12-15 September, Lisbon, Portugal.

- The presentation focuses on contr

- **Boiler MACT – How Combustion Improvements Help Meet Requirements** by the National Council of Air and Stream Improvement (NCASI), and the Council of Industrial Boiler Owners (CIBO) shows how increased emissions control technologies and improvements in the boiler design that determined changes were needed.

- Because the time for compliance was court-ordered, the EPA was required to propose new Federal District Court guidelines. This took a lot of time to prepare and develop and the EPA was required to further evaluate the emissions database and to propose the rules based on the comments and the new information that was received. The team spent a lot of time reviewing and reviewing another round of comments, and to produce the final rules by April 2012. However, the extension request was made by a “final” update, the update was made to February 2011. Several significant changes were made to the rules in comparison to the previous proposal and the EPA has left the door open for reasonable reconsideration. Boiler and process heater owners are now faced with another three-compliance period. The question remains - will this be the final version of the rules?

- Some of the key changes in the most recent version of the Boiler MACT rules as applied to biomass-fired boiler sti


- The presentation discusses the fundamentals of CO formation and destruction, and provides a recommended “engineered” approach to meet the new emissions requirements for units that would exceed the new limits. For further information and specific inquiries, please contact John La Fond at 425.952.2662 or Arie Verloop at 425.952.2625 or by e-mail at firstname.lastname@jansenboiler.com.

- **Combustion System upgrades for biomass boilers**

- **Combustion system upgrades for RDF-fired boilers**

- **Superheater and economizer upgrades and/or new supply.**

- **Biomass and RDF boilers engineering evaluations.**

- **Chemical recovery boiler performance evaluations and capacity studies.**

- **Chemical recovery and biomass boilers evaluation to meet generation power upgrades.**

- **Supply of injection materials for DBCC disposal in biomass boilers.**

- **CFD modeling of biomass, chemical recovery, RDF, and RDF-fired boilers.**

- **Boiler operational fine-tuning and optimization support.**

- **Boiler MACT and CVSS compliance support.**

**This work was conducted, or is currently in progress for the following companies:**

- Astania Utilities
- Black Rock Cellulose Inc.
- BTV Siliciclan Inc.
- Canfor
- Canmet Energy
- Capital Paper Company
- Cott Corporation
- Crown paper
- GS Paper
- Domtar Inc.
- Georgia-Pacific LLC
- International Paper Company
- Kimberly-Clark
- Lignin Energy
- McDermott
- Materialise
- Mondelez
- MSD
- New York State Corporation
- Orange County Container Group
- The Portland Paper Corporation
- Tennessee Valley Authority
- Stop & Shop
- Stop & Shop Southwest
- Stop & Shop Midwest
- St. Louis Power Plant
- Todd Industries
- Thermal Power Plant Zevlon
- West Virginia Power Plant

**For further information on these types of projects, please contact Arie Verloop at 425.952.2662 or by e-mail at firstname.lastname@jansenboiler.com. Additional information and specific project references can be found on our website at: www.jansenboiler.com.**

**Jansen Conference Welcome**

**Andrea Stitz**

We are also pleased to announce that Andrea Stitz has recently joined Jansen. Andrea graduated from the University of Washington with a B.S. degree in Mechanical Engineering. Among her skills set, she counts energy conversion, heat transfer, and fluid transportation.

On a lighter note: With Andrea’s hiring, both Jansen’s sailing and Spanish speaking capabilities have been greatly enhanced, as she is a sailing fan and can speak Spanish fluently.

Andrea is working as a Process Engineer in Jansen’s Process Engineering department. She can be reached at: (425) 952-2823 or e-mail: andrea.stitz@jansenboiler.com. Please join us in welcoming Andrea.

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**UPF Update on Biomass Boiler Combustion System Upgrades**

Since the late 1970s, Jansen has designed and supplied combustion system upgrades on a variety of steam boilers, from small CFB to RDF-fueled boilers. Currently, projects are under contract for RDF and CFB boilers, with planned completion dates for the majority of projects in the fall of 2011. Meanwhile, Jansen is planning to introduce new boiler system upgrade projects in November this year.

Typically, a combustion system upgrade includes modifications to the biomass fuel and/or air delivery systems, particularly the fuel delivery distributors and overfire air (OFA) supply, depicted in the sketches on the right and shown in the photos on page 4.

Jansen’s OFA system upgrades have provided significant reduction in CO emissions (reductions by more than half) through using an excellent tool for meeting boiler MACT requirements.

Further detailed information of the Jansen approach and experiences in upgrading combustion systems of biomass-fired boilers, including OFA upgrades, can be found on our updated website (www.jansenboiler.com) with technical descriptions and past newsletter articles.

Readers may wish to attend one of Jansen’s Biomass Boiler Workshops. As has been a tradition for ten years, again in 2011, biomass boiler workshops will be held in two locatio

**For specific inquiries and for more information, please contact Arie Verloop at 425.952.2662, or bye phone at 425.952.2667 or by e-mail at firstname.lastname@jansenboiler.com.**

**UPDATE ON Biomass Boiler Combustion System Upgrades**

**Paints & Coatings Society**

**Boiler House Carbons on Jansen Website**

A collection of boiler carbon monoxide emissions can be viewed on our web-site: www.jansenboiler.com. Over thirty cartoons by Gordon Storrs shown previously in this newsletter and presented on the site. Each cartoon depicts a humorous situation about carbon monoxide equipment in the boiler house. As you will agree, carbon monoxide generators by far outnumber the humors in the operation of industrial boilers and we hope you enjoy these cartoons as much as we do.
Based on the study findings, Jansen recommended that the existing overfire air (OFA) delivery systems be replaced with modern high capacity OFA systems located on the boiler’s side walls and that the fuel distributors be replaced with “new style” RDF distributors at a lower elevation.

The recommended upgrades, along with other improvements and maintenance work, were installed during separate boiler outages between November 2010 and May 2011. Initial operation of the units that were upgraded first has demonstrated the following results:

- Boiler steam flows can now be maintained in the 150,000 lb/hr range without requiring shutdowns to lower the average CO emissions.
- CO emissions have been reduced by more than 50%.
- NOx emissions compliance is also being achieved.
- Sustained boiler operation, no longer requiring shutdowns, has significantly increased the facility’s RDF burning capacity.

Based on these four upgrades, the owner has been very pleased with the quality of the design/ supply work by Jansen as well as the initial operational performance of the units after the upgrades.

- **OFA Nozzle on Boiler “B”**. Jansen completed a similar project – but with entirely different initial goals – on another RDF boiler in operation in an E-14 facility in New England. The unit was also supplied by Combustion Engineering (in 1987) for co-firing of RDF and stoker coal and was designed to generate 225,000 lb/hr of steam at 125 psi and 888 psig from RDF only. The unit was typically operated below its MCR steam flow to prevent exceeding the daily CO emission limit. Jansen was first contracted to conduct a comprehensive engineering evaluation, including CFD modeling and circulation study, to evaluate the impact of permanently removing the furnace water-cooled screen section on the superheater life expectancy since this screen was in need of replacement.

- **OFA Upgrade on Boiler “B”**. In the fabrication shop gas temperatures at the superheater inlet, thereby accentuating corrosion rates in the superheater and emphasizing the need to retain the screen section. Modeling showed that upgrading the OFA delivery system and removing the screen would result in a decrease in peak corrosion rates by over 10%, as compared to an increase by nearly 10% if the screen section were to be removed without modifying the OFA system.

The plant moved forward following Jansen’s recommendations and upgraded OFA delivery system components were installed during the March 2011 boiler outage.

Initial operation of the unit after the OFA system upgrade has been “... a complete success...” as quoted by plant personnel, in part due to the increase in RDF burning rate and decreased CO emission levels. The OFA upgrade also provided improved combustion control, allowing implementation of a CO trim control loop.

Long term operation will reveal if the predicted benefits on corrosion can be quantified and that removal of the screen section is warranted.

- **OFA Nozzle on Boiler “C”**. The upgrades on the RDF boilers in facilities “A” and “B” came on the heels of an OFA delivery system upgrade that was supplied by Jansen to a RDF-fueled boiler in the upper mid-west three years ago. This Riley Stoker unit had been converted to burn RDF on a traveling grate in 1989 and has a design steam capacity of 174,600 lb/hr. Prior to the OFA upgrade, at times, natural gas was co-fired with the RDF to control CO emissions. The purpose of the OFA delivery system upgrade was to lower CO emissions, reduce natural gas co-firing, and here the ability to burn additional RDF and generate more steam.

With the OFA upgrade, all of Jansen’s performance guarantees were met. Operation with the new OFA system and the implementation of an oxygen time log has resulted in the following documented performance improvements:

- A 12% average increase in RDF firing and steam generation rates.
- Ability to operate at lower flue gas oxygen levels while maintaining CO and NOx compliance.
- Reduced frequency and magnitude of CO emission spikes.
- Reduced need for natural gas co-firing to remain within emissions compliance.

For further information on this recent work and specific inquiries about potential future projects, please contact Arie Verloop at 425.925.2805 or by e-mail at arie.verloop@jansenboiler.com.
Since 2000, these workshops have been attended by some 675 representatives of numerous plants in the Pulp/Paper Products Industries, Independent Power Producers and Energy-from-Waste Industry.

The workshops consist of presentations about new technological developments and results to improve the operating performance, waste fuel burning capacity, efficiency, and fuel-availability of biomass-fueled boilers (mostly stoker-fired). In addition, the program will include troubleshooting and problem solving discussions of challenges that attendees bring to the workshops. Participants will benefit by 1) learning about the current retrofit technology for biomass boilers and associated equipment; 2) seeing how other mill operations solve their biomass boiler area problems; and 3) receiving information and solutions to their specific problems. Attendance to the workshop is free of charge; space is limited.

The workshops are co-sponsored by:

For sign-up and to receive a detailed program of the technical presentations, workshop location, and hotel, etc., please contact Pat Fischer or Cathy Thomas by phone at (425) 825-1131 or by e-mail at info@jansenboiler.com.

Website Update

Earlier this year, we incorporated a major upgrade and modernization of our website. Go see: www.jansenboiler.com. Whence, the design and layout of the old site had served us well for many years, a new look was needed. With this new look, no changes have been made to the in-depth (technical) content of the site, including detailed capabilities and project descriptions, technical papers, etc., as well as a collection of over thirty boiler house cartoons by Gord Stevens.

Jansen Projects in Canada

In Canada, the department of Natural Resources is implementing the Pulp and Paper Green Transformation Program (GTP); a total of CAD$1 billion is being made available to mills for capital projects that have a positive impact on the environment, energy efficiency, and expanded use of renewable fuels. This past year, Jansen was awarded several projects that are supported by the GTP in mills in Kamloops, Port Alberni, Prince George, Queen (all BC), The Pas (MAN.), and Windsor (ON). Several more are currently under consideration.

Receive Our Newsletter by E-mail

This newsletter, No. 36, Spring 2011, is again being sent by e-mail to our contacts for whom we have an e-mail address. It will also be sent via regular postal service. We are continually expanding the electronic distribution list for our bi-annual newsletter. To receive future newsletters, you are given the following choices:

• Prefer receipt by e-mail (no regular mail)
• Prefer receipt by regular mail (no e-mail)
• Prefer both mailings (e-mail and regular mail). If we do not hear from you, we will assume this choice.

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