2020 **Title:** **Boiler Retrofit Improves Efficiency and Increases Biomass Firing Rates**

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ABSTRACT:

The Domtar Paper Company LLC's (Domtar's), mill in Plymouth, North Carolina, has relied on two biomass/hog fuel fired boilers (HFBs) to meet the mill steam demand requirements. As part of a mill energy consolidation and reliability improvement effort, the mill wished to decommission the No. 1 HFB and refurbish/retrofit the No. 2 HFB.

The No. 2 HFB was originally designed to burn pulverized coal and/or biomass on a traveling grate. The maximum steaming capacity was 500,000 lb/hr from firing coal and 400,000 lb/hr from biomass. However, the boiler was never able to sustain this design specified biomass steaming rate.

As the mill's sole power boiler, the No. 2 HFB would need to sustain 400,000 lb/hr of steam during peak load periods. Domtar wished to achieve this steaming rate while firing biomass alone. An evaluation conducted by Jansen Combustion and Boiler Technologies, Inc. (JANSEN), incorporating field testing, analysis, and computational fluid dynamics (CFD) modeling, identified the following key bottlenecks and deficiencies to achieving this goal:

- Existing combustion system performance (fuel delivery and overfire air (OFA)) was inadequate.
- Insufficient heat capture resulted in stack gas temperatures of around 500°F, indicating significant energy losses.
- Combustion air temperatures were excessive and approached the design limit of the supply ducting.
- Sweetwater condenser (SWC) capacity was inadequate.
- High pressure drops across the electro dry-bed scrubbers limited the induced draft (ID) fan capacity.

The following upgrades were engineered and supplied to address these deficiencies:

- Modern pneumatic fuel distributors for effective biomass delivery to the grate.
- A modern sidewall, interlaced OFA system.
- A new economizer design with more than twice the surface area of the existing unit and improved erosion protection.
- New flue gas breeching with turning vanes between the generating bank and economizer.
- Increased SWC capacity by modifying the feedwater piping to feed the SWC before the new economizer.

The mill also replaced the scrubber with a dry electrostatic precipitator (ESP), and the boiler controls logic was upgraded.

The following benefits have been realized:

- Stack gas temperatures have been lowered by 130°F.
- Combustion air temperatures have been lowered by 100°F.
- The boiler has achieved the target steam generation rate of 400,000 lb/hr from biomass firing.
- All mandated emissions limit tests at 500,000 lb/hr of steam with 400,000 lb/hr of steam being generated from biomass firing were passed.
- The mill reports a 10% reduction in fuel firing rates at the same steaming rate.

The mill now has the confidence to decommission the No. 1 HFB, which will substantially lower operating and maintenance costs.

This paper describes the elements leading to a successful project, including data collection, process analyses, CFD modeling, design, engineering, equipment supply, operator training, and start-up assistance.