FINAL SCIENTIFIC REPORT

**MANUFACTURING CONVERSION FOR
ENERGY EFFICIENCY**

DOE Agreement No. DE-FG36-08GO88018

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Final Report

Executive Summary

The Flambeau River Papers “Manufacturing Conversion for Energy Efficiency” Project has identified the following goals and objectives:

1. A low pressure accumulator tank will be installed to capture low pressure gases for reuse. The estimated cost is \$2.1 million with an energy savings of \$500,000 annually or enough natural gas savings to heat 590 average Wisconsin homes.
2. Replace the steam turbine and upgrade Paper Machine #3, the largest of Flambeau River Papers machines, at a cost of \$6.265 million. The result will save enough natural gas to heat 141 average homes, or about \$1.2-million each year.
3. Install a new cyclonic and cell fracturing technology dryer to reduce moisture in both sludge and biomass wastes. The estimated cost of this task is \$1.5-million with an annual energy savings of \$700,000. It will also eliminate all coal burning at Flambeau River Papers (7,200 tons of coal annually).

Project Description

The Flambeau River Papers “Manufacturing Conversion for Energy Efficiency” Project is very important to the reduction of industrial fossil fuel usage, particularly as a model for the paper and pulp mill industry. Flambeau River Papers continues to strive to be the first integrated pulp and paper mill in the nation to operate without the use of fossil fuels. This grant brings us that much closer to making this goal a reality. It is estimated that the Economic Impact of a Pulp and Paper mill with the size and geographic location of Flambeau River Papers is nearly \$200 million annually. Due to the impact of such a grant, serious consideration and effort has been expended to select those activities for the energy project that will provide maximum benefit to achieving energy independence. The main activities are split into three main Tasks: Task 1.0 - Pulp Mill Low Pressure Accumulator; Task 2.0 - Paper Machine # 3 Drive and Systems Upgrade; and, Task 3.0 - Waste Water Treatment and Utilities Sludge and Biomass Dryer. Our team has determined that these activities give the best return on investment and long term benefits. It must be noted that current costs are estimates attained through due diligence but are not hard costs which will be determined upon funding and issuance or purchase orders. There may be minor shifts in funding between activities but the overall cost of all activities should remain consistent.

Appendices

- Appendix A. Final Task Schedule
- Appendix B. Final Spending Schedule
- Appendix C. Final Cost Share Contributions
- Appendix D. Energy Savings Metrics

Supplemental Information

Appendix A

Final Task Schedule

Final Task Schedule

Task Number	Task Description	Task Completion Date				Progress Notes
		Original Planned	Revised Planned	Actual	Percent Complete	
1	Low pressure accumulator				100%	Completed.
2	Paper Machine # 3 Drive and Systems Upgrade				100%	Completed.
3	Waste Water Treatment and Utilities Sludge and Biomass Dryer				100%	Completed.

Appendix B

Final Spending Schedule

Final Spending Schedule

Project Period: mm/dd/yy to mm/dd/yy

Task	Approved Budget	Final Project Expenditures
Task 1 Low pressure accumulator	\$2,324,661	\$2,121,390
Task 2 Paper Machine # 3 Drive and Systems Upgrade	\$6,178,383	\$5,636,972
Task 3 Waste Water Treatment and Utilities Sludge and Biomass Dryer	\$1,544,625	\$2,150,243
Total	\$10,047,669	\$9,908,605
DOE Share	\$4,724,000	\$4,724,000
Cost Share	\$5,323,669	\$5,184,605

Appendix C

Final Cost Share Contributions

Final Cost Share Contributions

Funding Source	Approved Cost Share		Final Contributions	
	Cash	In-Kind	Cash	In-Kind
WI DOC	\$4,600,000		\$4,600,000	
FRP	\$465,398	\$258,271	\$413,477	\$303,227
Total	\$5,065,398	\$258,271	\$5,013,477	\$303,227
Cumulative Cost Share Contributions				\$5,343,704

Appendix D

Energy Savings Metrics

One Unit of Proposed Technology:

Part 1 of this proposal installed an electric drive on the no.3 paper machine. This required the use of additional electricity, but this was offset by the steam (produced from natural gas) savings.

Part 2 of this proposal installed a low-pressure acid accumulator in the sulfite pulp mill. This accumulator allows the capture and reuse of hot gasses from the digester without cooling.

Part 3 of this proposal installed a system to mechanically remove water from the paper mill sludge and biomass waste. The dried biomass would then be used as fuel in the biomass boiler. The dried sludge would be landspread using reduced transportation fuel.

One Unit of Current Technology:

Prior to the installation of the electric drive the paper machine was driven by a steam turbine. The steam exhausted from this turbine was used in the drying section of the paper machine. The amount of steam required by the turbine did not match the steam required by the dryers and the excess steam was wasted.

Prior to the installation of the low-pressure accumulator the hot gasses were captured but had to be cooled before reuse. The heat removed in the cooling process was wasted.

Currently the paper mill sludge is applied to the land at about 70% solids. The biomass waste is used as fuel at about 40% moisture.

Discussion of Energy Savings:

The values used for the energy savings are calculated values.

Comparing the actual gas used in the first 10 months of 2008 and the first 10 months of 2010 indicates a 20% reduction or about 100,000 mmbtu. This savings is for the entire mill so other steam users will affect this value.

Similarly, the electric use over this period increased by 7.6 million kwh or 80,442 mmbtu. Again, this is based on the entire mill electrical use and many things affect this value.

The calculated savings for the sludge and biomass dryer were not included as this system did not result in any energy savings.

Energy Savings Metrics

Type of Energy Used	A	B	C=A-B	D	E=CxD
	Current Technology (Btu / yr / unit)	Proposed Technology (Btu / yr / unit)	Energy Savings (therms / yr / unit)	Estimated Number of Units in U.S. by 2010 (units)	Energy Savings by 2010 (Btu / yr)
Oil / Gasoline					
Natural Gas			1,772,730		
Coal					
Electricity (@ 10,500 Btu / kWh)			-400,807		
Other Energy 1 (Explain)					
Other Energy 2 (Explain)					
Other Energy ...n (Explain)					
Total Per Unit			1,371,923		