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NorskeCanada

## Crofton Division

### #4 Power Boiler – Alternative Fuels Trial Plan

Submitted by: Graham Kissack – Director, Environment

August 2003

## 1. Summary

NorskeCanada proposes to conduct a 30 month trial of burning three different alternative fuels in its #4 wood waste power boiler (discharge currently authorized by air emissions permit PA-1902).

- ?Bituminous coal will be applied to a maximum of 20% by heat value of total boiler load. A similar trial in a waste wood boiler at the Elk Falls mill found that there were no major environmental issues arising from the use of coal as an auxiliary fuel.
- ?Tire Derived Fuel (TDF) which is currently used as an auxiliary fuel at two other NorskeCanada mills (Port Alberni and Powell River) will be applied at up to 10% by mass of hog fuel.
- ?Hogged waste railway ties will be applied with the existing hog fuel supply up to a content of no greater than 15% by mass of the hog fuel supplied to the boiler. This fuel type is currently used at Northwood Pulp in Prince George in their power boilers, at TransCanada Power in Williams Lake in their cogeneration facility, and at a former Fletcher Challenge papermill facility in Blandin, Minnesota.

It is proposed that this trial will be conducted under the authority of an amended permit to be issued by the Regional Waste Manager. To fully understand the effects of these alternative fuels on Crofton boiler operations and its waste streams, a comprehensive testing program is planned for the trial which will test the solid waste, air emissions, and local working conditions as well as monitoring the economic and operational impacts. A trial summary will be submitted to WLAP upon completion of the work.

## 2. Alternative Fuel Trial Objective

The objective of the trial is to test the effectiveness of using bituminous coal and TDF as auxiliary fuels and waste railway ties as an alternative woodwaste source in the #4 power boiler which burns waste wood, primary and secondary sludges and currently #6 fuel oil or natural gas as auxiliary fuels. Impact on stack emissions, ambient air quality, solid waste quality and quantity, operational impacts, and economics will be determined.

### 2.0 Boiler Operation

The #4 power boiler at Crofton is a Foster Wheeler large travelling grate unit that has been in service since 1978 (see Appendix 1 for full details). This boiler burns approximately 735 volumetric units per day of hog fuel and uses natural gas or #6 fuel oil as auxiliary fuel. In 2002, the boiler generated on average 323,000 lbs/hr of steam with 73.9% (246,000 lbs/hr) generated by burning hog fuel and sludges. The maximum total firing rate in this period was 473,800 lbs/hr and the 90<sup>th</sup> percentile total firing rate was 415,000 lbs/hr.

### 2.1 Boiler Emissions and Ambient Air Quality

As shown in Figure 1, the new precipitator on the #4 power boiler has outperformed original design expectations and permit requirements with current particulate emissions averaging 53 mg/m<sup>3</sup> (@ 12% CO<sub>2</sub>) since commissioning in May 2001. Similarly, the rolling four month average is currently 80 mg/m<sup>3</sup> (@ 12% CO<sub>2</sub>). Ambient particulate levels near the mill at the substation and south monitoring stations continue to show levels well below provincial standards (see Figure 2). We expect no measurable increase in particulate emissions or impacts on ambient particulate levels with use of these fuels.

### #4 Power Boiler Particulate

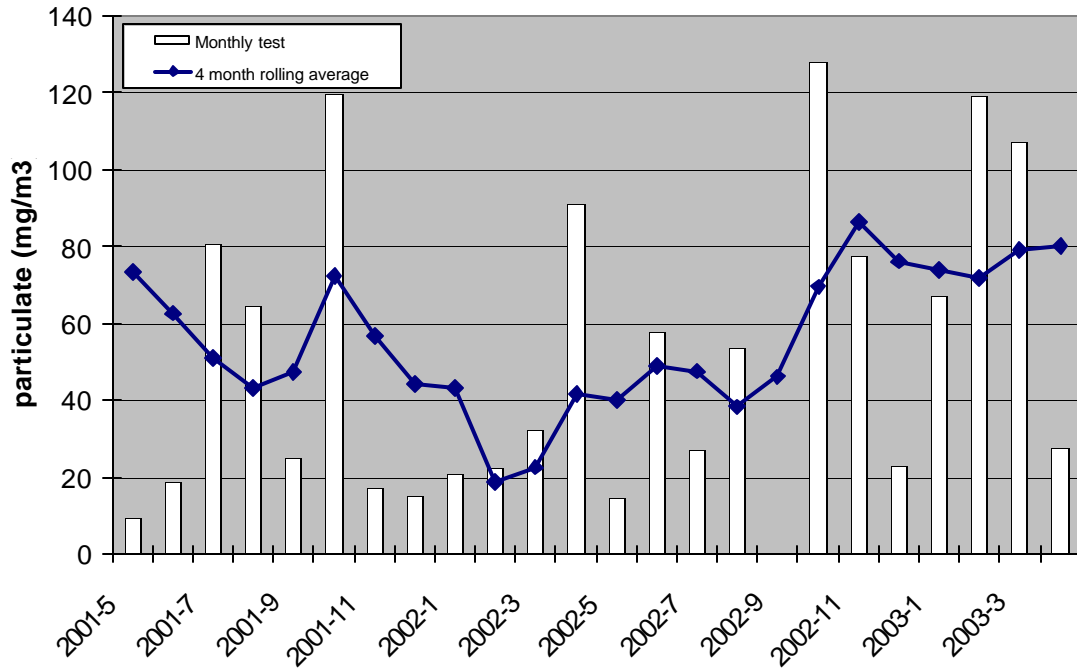


Figure 1

### Ambient Particulate

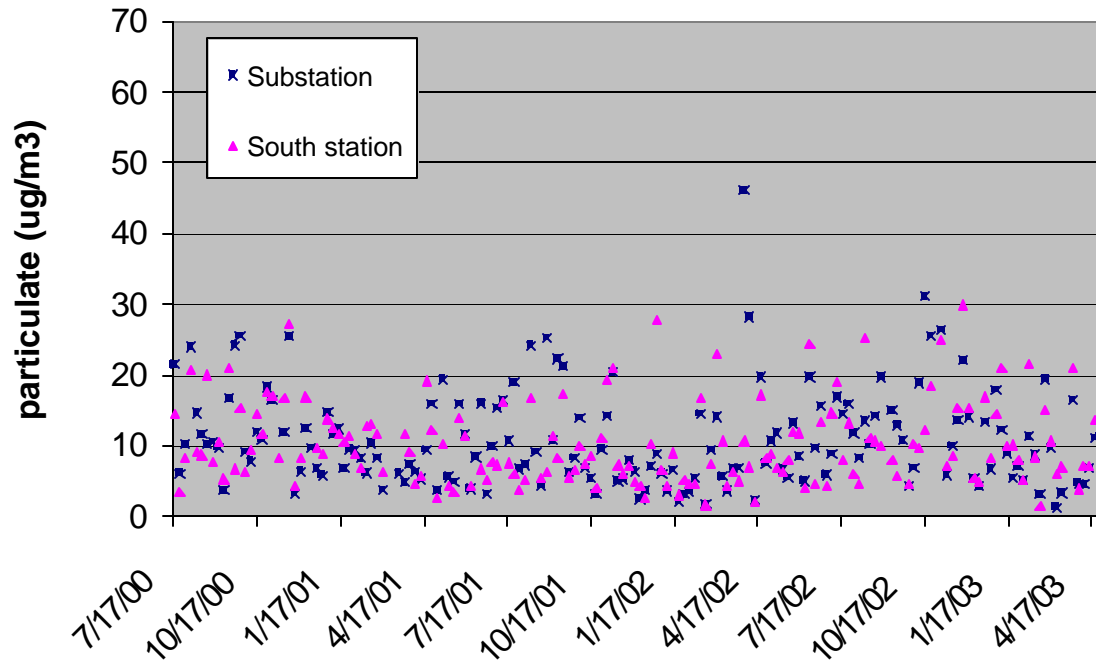


Figure 2

Limited testing of the power boiler emissions for SOx, NOx, and metals has been conducted in the past. Recently, the boiler was tested under normal operating conditions for SOx and NOx with results of SOx between 112 mg/m<sup>3</sup> and 185 mg/m<sup>3</sup> and NOx results of 175 mg/m<sup>3</sup>.

Substantial dioxin and furan emissions testing of the #4 power boiler has been conducted since 1993 in conjunction with research work undertaken by coastal mills co-operating with PAPRICAN to uncover approaches to eliminating its formation. Since May 2000, the boiler's dioxin TEQ levels have averaged 0.11 ng/m<sup>3</sup> (@ 11% O<sub>2</sub>) which is well below the 2006 federal standard of 0.50 ng TEQ/m<sup>3</sup> (@ 11% O<sub>2</sub>) for dioxin emissions from existing salt laden power boilers (see Figure 3).

### #4 Power boiler dioxin

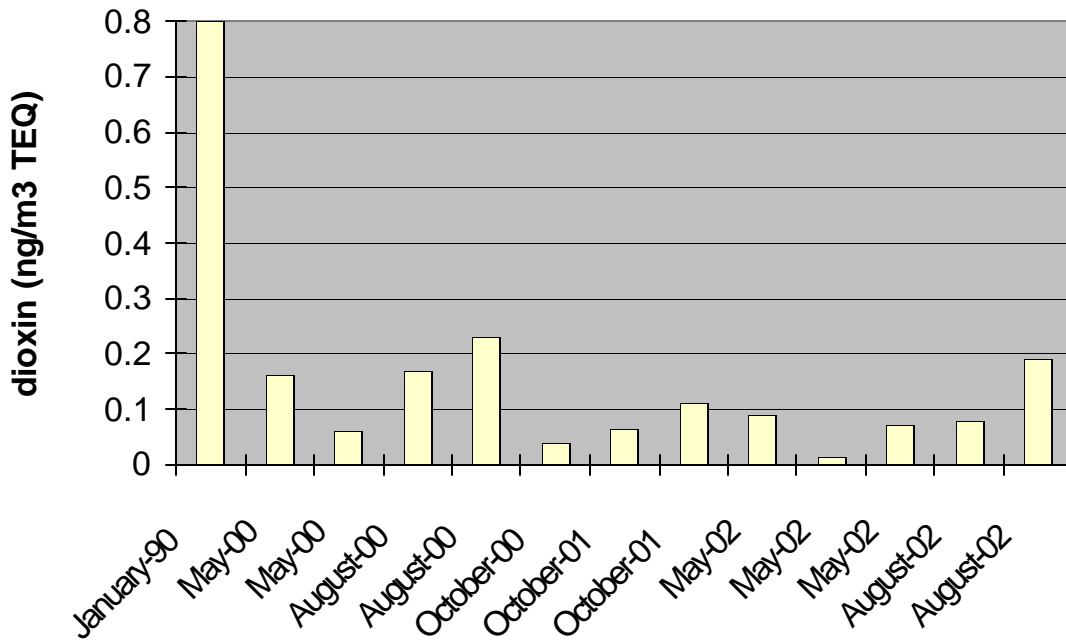


Figure 3

### 3. Coal Trial

#### 3.0 Benefits of Coal

There is a strong interest in using Vancouver Island coal as an auxiliary fuel. Primary reasons include the preferred economics of using coal over natural gas or oil. Additionally, money spent on coal purchases stays on Vancouver Island supporting local industry. We intend on using coal from Quinsam Coal Corporation located near Campbell River. The certificates of analysis (which were generated during the Elk Falls trial) are located in Appendix 2 and it is interesting to note that the coal contains less sulphur than the #6 fuel oil currently burned and would likely result in lower SO<sub>2</sub> emissions. Sulphur content in the Quinsam Coal is typically between 0.2 and 0.7% sulphur. It is hoped that the coal will improve the temperature of the combustion bed in the boiler thereby improving combustion stability. Better combustion will result in reduced solid waste generation and potential reductions in dioxin generated by the sea salt containing hog fuel.

#### 3.1 Elk Falls Mill Coal Trial Results

The NorskeCanada mill at Elk Falls in Campbell River completed a similar trial in 2002 under Approval AA-16544 (see full report in Appendix 3). Although there were some issues with the design of the trial including the performance of the coal metering equipment and the wet electrostatic precipitator the results did not indicate that there were any environmental issues arising from the use of coal as an auxiliary fuel. It was concluded that the use of coal doesn't have any significant effect on particulate emissions, PAHs and dioxins/furans are significantly reduced when burning salty hog compared to gas or oil and that metals are unlikely to be discharged at levels which pose a significant environmental or human health risk. The air emissions permit (PA- 3341) was subsequently amended to allow the use of coal as an auxiliary fuel until September 30, 2005. During this period the mill will be conducting additional monitoring to characterise the emissions under normal boiler conditions.

#### 3.2 Proposed Crofton Coal Trial Method

A trial would be conducted to give the mill an opportunity to assess:

- ☒☒ How to feed and blend coal into hog fuel.
- ☒☒ How coal will behave in the boiler
- ☒☒ Coal's benefits on different types of hog fuels and salt levels
- ☒☒ Coal's impact on air emissions and ambient air quality near the boiler
- ☒☒ Coals impact on landfill volumes and ash quality
- ☒☒ The benefits of different coal addition rates of up to 20% by heat content

We propose six trials in which we vary fossil fuel source, addition rates of coal, and the quality of hog fuel. All trials will be run at elevated firing rates in the boiler at about the 90<sup>th</sup> percentile.

Condition	Trial Number					
	1	2	3	4	5	6
Coal Addition Rate (% heat content)	0%	10%	20%	20%	10%	20%
Hog Salt Level	typical	typical	typical	high*	typical	typical

Oil Auxiliary fuel**	yes	yes	yes	yes		
Gas Auxiliary fuel**					yes	yes

\* High salt content hog fuel will have above 1.0% NaCl content

\*\* Auxiliary fuels will be used only if required to maintain proper combustion conditions

Coal Trial Schedule	
Schedule	Action
Phase 1	Set up and prove coal-metering equipment
Phase 2	Run varying levels of coal to assess feeding rates and boiler operational issues
Phase 3	Test on high coal and low coal addition rates Test on typical and high salt content hog fuel Test on oil and gas auxiliary fuels
Phase 4	Assess solid waste generation and quality Assess local worker conditions

### 3.3 Coal Trial Testing

The use of up to 20% coal in the #4 power boiler is not expected to substantially change the emissions characteristics of the process. The following is a list of air emissions tests to be conducted under each of the trial operating conditions.

Air Emissions Testing	
Parameter	Frequency per variable
Particulate	one triplicate test
Flow Rate	one triplicate test
Temperature	one triplicate test
Moisture	one triplicate test
Oxygen	one triplicate test
Carbon Monoxide	Continuous emissions monitor
NOx	Continuous emissions monitor
SO2	Continuous emissions monitor
Total Hydrocarbons (volatile and non)	Continuous emissions monitor
Trace metals	one triplicate test
PCDD, PCDF and PAH	Single samples under typical salt hog condition with 10% and 20% coal
Greenhouse Gases	one triplicate test

Quantity and quality of the solid waste ash generated by the boiler will also be tested for the following parameters.

Solid Waste Testing under Each Condition	
Parameter	Frequency per variable
Solid waste generation rates	Duration of test
Ash sulphur content	One composite per trial
Ash carbon content	One composite per trial
ICP metal scan of ash	One composite per trial
PCDF and PCDD	Single samples under typical salt hog condition with 10% and 20% coal

Testing of work place conditions around the coal offload system and the boiler operation will be conducted during the trial to ensure WCB compliance. The following parameters will be tested before and during the trial:

WCB Workplace Conditions Testing		
Parameter	Coal feed system	Boiler operations area
Respirable Coal Dust	3 locations at 20% coal	3 locations at 20% coal
Ambient Coal Dust	3 locations at 20% coal	3 locations at 20% coal
Full ICP metal Scan on particulate catch	3 locations at 20% coal	3 locations at 20% coal
Ambient Arsenic	3 locations at 20% coal	3 locations at 20% coal
Ambient Cadmium	3 locations at 20% coal	3 locations at 20% coal
Ambient Lead	3 locations at 20% coal	3 locations at 20% coal
Ambient Mercury	3 locations at 20% coal	3 locations at 20% coal

### 3.4 Reporting on the coal trial

The mill will submit a formal written report to WLAP for the trials of coal, TDF, and railway ties upon completion of the trials and testing of the various samples.

## 4. Railway Tie Trial

### 4.0 Benefits of Burning Railway Ties

About 85% of the fine particulate emissions from the Crofton #4 power boiler are sodium chloride (NaCl) which is a contaminant in the hog fuel as a consequence of ocean log booming. The NaCl vaporizes in the boiler's furnace and resolidifies before the precipitator. At elevated temperatures, the NaCl has very sticky characteristics and inhibits the precipitator and its rappers to remove the particulate. Use of alternative salt-free wood based fuels such as waste railway ties would reduce the salt load on the boiler improving its fine particulate performance. This is very beneficial especially in light of the recent CEPA declaration that fine particulate is toxic. Currently available waste railway ties would account for about 1.5% to 2.5% of Crofton's waste wood supply to the #4 power boiler.

Clearly, burning of railway ties is also beneficial in the avoidance of solid waste streams going to landfill and the management of leachates from those sites.

### 4.1 Experience Burning Railway Ties

Today, there are several facilities burning railway ties to generate steam. Three such facilities are the TransCanada Power facility in Williams Lake, the Canfor Northwood Pulp facility in Prince George, and the UPM Paper facility formerly owned by Fletcher Challenge Canada in Blandin Minnesota.

#### 4.1.1 TransCanada Power

TransCanada Power was given an authorization by the WLAP Williams Lake office to conduct a five day trial in April 2001 burning 100% hogged railway ties (supplied by CN Rail) in their cogeneration facility at Williams Lake (Appendix 4). The facility is equipped with multiclones and an electrostatic precipitator and operates at 1100 Celsius with a residence time of 2.5 to 3.0 seconds. The Crofton #4 power boiler has similar infrastructure and operating conditions. The provisions of the trial included:

- ☒☒ Duration of no more than 5 days
- ☒☒ Test burn using 100% railway ties at 450,000 lbs/hour steam
- ☒☒ Railway ties were restricted to creosote and pentachlorophenol treated wood (ie. No heavy metal preservatives)
- ☒☒ Permittee was required to conduct testing for particulate, SO<sub>2</sub>, HCl, trace metals, dioxin and furan, PAHs and chlorophenols for both baseline conditions and conditions during the trial burn on the stack. The solid waste streams were required to be tested for dioxins and furans, PAH's, chlorophenols, and trace metals for the baseline and trial burning conditions.
- ☒☒ Permittee to undertake an ambient impact assessment

The trial found no material increase in the emissions of particulate, trace metals, dioxins and furans, and PAHs (Appendix 4). The testing indicated increases in chlorophenols, SO<sub>2</sub> and HCl. However, ambient air modeling of these emissions showed there would be little impact on ambient concentrations.

The WLAP Williams Lake office issued an amended permit (PA 8808) in early 2003 for the facility to permanently burn railway ties. The amended permit did not specify any

additional emission characteristics or testing requirements due to the burning of the railway ties nor was a maximum loading rate for the waste ties specified. There was a prohibition on the burning of railway ties that had been treated with heavy metal derived preservatives.

#### 4.1.2 Northwood Pulp

Northwood Pulp has an allowance (Appendix 5) in their air emissions permit (PA 02559) to burn up to 10% by mass of hogged railway ties in two of their hog fuel power boilers. This follows trials in 1989 by WLAP and Environment Canada that determined operating conditions in the power boiler were sufficient to achieve virtual destruction of chlorophenols and dioxins with the boiler's 920°C temperature and 3 second residence time. The fuel used during the trial contained up to 400 ug/g chlorophenols which were destroyed above 99.99% efficiency. Waste railway ties are expected to have a chlorophenol concentration much less than 400 ug/g.

The Crofton #4 power boiler operates between 1100°C at the grates to 850°C at the top of the furnace with a residence time of about 3 seconds. Virtual destruction of railway tie chlorophenols and dioxins is anticipated.

#### 4.1.3 Blandin Paper, Minnesota

The former Fletcher Challenge Canada paper mill facility in Blandin, Minnesota burns railway ties in their woodwaste power boiler. In 1997, the boiler was re-certified to continue its operation. The testing included the firing of railway ties up to 15% by weight of the incoming boiler fuel. Testing results yielded low levels of SO<sub>2</sub>, NO<sub>x</sub> and particulates (Appendix 6).

### 4.2 Chemical Characteristics of Railway Ties

Thousands of tonnes of railway ties are disposed into landfills each year. They are treated with creosote and/or pentachlorophenols to preserve them against attack by rot and insects. Since waste railway ties are treated with wood preservatives or wood protection products that are registered under the Pest Control Products Act, waste railway ties are not considered special wastes. The CCME document "Provisional Code of Practice for the Management of Post Use Treated Wood" indicates that controlled burning with energy recovery as one very acceptable method of disposal.

Waste railway ties from prospective suppliers were sampled for phenolics, PAHS, oil and grease, metals and other compounds (Appendix 7). The results generally show levels below 100 ppm for cresols, phenols, naphthalene, xylenols, PAHs, and chlorophenols. Heavy metals including arsenic, barium, cadmium, chromium, lead, mercury and zinc were all below about 25ppm. The approximate heating value of the ties is between 6,500 and 8,191 BTU/lb on par with typical hog fuels but without the sodium chloride content.

### 4.3 Railway Tie Trial Method

Hogged railway ties will be tested in the power boiler at three different application rates to help identify any impact on the boiler operations and emissions quality. Since the hogged ties will be very similar in composition to the existing hog fuel supply, no logistical time is required to assess handling approaches however appropriate metering facilities will be installed and tested prior to the trial.

Railway Tie Trial Schedule	
Schedule	Action
Phase 1	Set up and prove viability of using existing hog feed system Run varying levels of railway ties to assess feeding rates and boiler operational issues
Phase 2	Emissions test on increasing railway tie addition rates

Condition	Trial Number			
	1	2	3	4
Railway Tie Rate (% heat content)	0%	5%	10%	15%
Hog Salt Level	typical	typical	typical	typical
Gas or Oil Auxiliary fuel	yes	yes	yes	yes

#### 4.4 Railway Tie Trial Testing

Air emissions and solid waste emissions from the trials will be tested. The air emissions testing will be identical to that undertaken at the TransCanada Power facility. An independent contractor will test the emissions in each trial for the following characteristics:

Air Emissions Testing	
Parameter	Frequency per variable
Particulate	one triplicate test
Flow Rate	one triplicate test
Temperature	one triplicate test
Moisture	one triplicate test
Oxygen	one triplicate test
SO <sub>2</sub>	one triplicate test
HCl	one triplicate test
Trace metals	one triplicate test
Chlorophenols	one triplicate test
PCDD, PCDF and PAH	Single samples at 5% and 15% addition

Quantity and quality of the solid waste ash generated by the boiler will also be tested for the following parameters.

Solid Waste Testing under Each Condition	
Parameter	Frequency per variable
Ash sulphur content	One composite per trial
Ash carbon content	One composite per trial
ICP metal scan of ash	One composite per trial
PCDD, PCDF and PAH	Composites of 5% and 15% addition rates

#### 4.5 Reporting on the Railway Tie Trial

The mill will submit a formal written report to WLAP for the trials of coal, TDF, and railway ties upon completion of the trials and testing of the various samples.

## 5. Tire Derived Fuel (TDF) Trial

### 5.0 Benefits and Challenges of TDF

Tire derived fuel is made by stripping the bead wire from a tire and shredding the tire into pieces approximately 1 inch in size. A magnet is used to remove additional belt wire. Some wire remains embedded in the pieces of rubber.

The use of Tire Derived Fuel (TDF) at Crofton is expected to:

- ☒☒ Improve the ability to consume existing lower quality sources of hog fuel without the use of supplemental natural gas or #6 fuel oil.
- ☒☒ Improve fine particulate emissions due to more steady state boiler operation.
- ☒☒ Reduce the generation of wood ash from the boiler by improving the bed temperature and degree of combustion of the hog fuel
- ☒☒ Improve mill cost structure due to reduced auxiliary fuel costs.

A review of the literature on TDF burning in wood waste boilers indicates that zinc emissions are a potential environmental issue. The literature indicates that the majority of the zinc is converted to zinc oxide and is collected in the electrostatic precipitator. Our electrostatic precipitator is expected to perform very efficiently on this material. Further it is expected that the zinc in the ash, which is currently discharged to our permitted landfill will remain insoluble due to the relatively high pH of the ash. In addition, due to the current dry ash handling system, no discharge of zinc to the mill effluent treatment system will occur. Based on the experience at the Port Alberni and Powell River mills we do not expect any environmental issues resulting from the proposed TDF trial.

### 5.1 Experience burning TDF at Port Alberni and Powell River

#### 5.1.1 Port Alberni (NorskeCanada)

From March 1997 to March 1998, Pacifica Papers Inc. Port Alberni conducted a TDF trial under an Approval AA-15346 and submitted a report in April 1999. During the trial, they consumed approximately 1300 tonnes of TDF, equivalent to 150,000 passenger car tires. Their results indicate that the heat energy contained in the TDF resulted in an increased bed temperature which allowed increased hog consumption and lower natural gas consumption. Monitoring results of the stack emissions during the TDF trial indicated there were no increases in metals emissions or significant differences in the SO<sub>2</sub> concentration when burning TDF. PAPRICAN has speculated that the improved combustion conditions and sulphur addition from the TDF likely reduces the generation of dioxin and furans in the boiler. This has been subsequently verified in testing at both Port Alberni and Powell River.

Parameter	0% TDF	5% TDF
Particulate	77 mg/m <sup>3</sup> (27 – 170)	71 mg/m <sup>3</sup> (37 – 177)
Zinc (% of particulate)	0.13 - 0.45 %	0.13 - 0.37 %
Iron (% of particulate)	2.27 - 13.69 %	0.73 - 11.06 %
Chromium (% of particulate)	0.23 – 2.1 %	0.06 – 1.89 %
Sulphur Dioxide	28 ppm (19 – 37)	31 ppm (20 – 44)
Poly Aromatic Hydrocarbons	0.72 ug/m <sup>3</sup> (0.31 – 1.6)	0.73 ug/m <sup>3</sup> (0.72 -0.73)
Dioxin and furans	0.23 – 0.58 TEQ ng/m <sup>3</sup>	0.096 – 0.125 TEQ ng/m <sup>3</sup>

The company determined that they would find the biggest benefits from TDF during the winter months when the weather is wet. The company requested and received a permit amendment in order to routinely burn TDF, up to 5% of the total fuel feed.

#### 5.1.2 Powell River (NorskeCanada)

From January 6, 2003 to March 29, 2003, Powell River conducted an approved trial firing TDF in their hog fuel power boiler. An independent assessment of that trial was completed and filed in June 2003. During the trial, approximately 1490 tonnes of TDF were consumed at up to 5% by mass of the hog fuel supply. The independent assessment (see Appendix 8) concluded that the TDF improved the stability and combustion in the boiler as evidenced by reduced opacity and CO concentrations. NOx air emissions did not significantly change with increases in TDF application and SO2 emissions only marginally increased. Trace metals all remained unchanged except for chromium which increased. The consultant and mill both believe the elevated chromium is due to sample contamination.

Parameter	0% TDF	2% TDF	5% TDF
NOx mg/m3	142	138	141
SO2 mg/m3	27	30	49
CO ppm	104	60	78
Opacity %	1.5	1.14	1.00
Particulate mg/m3	11	6.2	3.2
Dioxin & Furans ng/m3 TEQ	0.048	No test	0.044
PAHs ug/m3	1.40	0.49	0.81
VOCs mg/m3	2.14	1.6	2.8
Chromium mg/m3	0.00214	0.00222	0.0121
Zinc mg/m3	0.021	0.0106	0.0155

Overall, the consultant concluded on the Powell TDF trial that...

“TDF use in the winter of 2003 did not show any significant or likely measurable environmental effects. The air emissions rates of VOCs, trace contaminants including metals, dioxins, and PAHs are well within government criteria intended to protect public health and the environment. The ambient concentrations of those contaminants are below levels considered protective of public health. Also, contaminant emissions during the TDF trial were generally the same or lower when compared to the baseline (with the exception of SO2 which showed a minor increase but with ambient concentrations well within air quality objectives designed to protect public health and the environment).”

## 5.2 Characteristics of TDF

The USEPA has reported that 64% of the scrap tire market in the US is used as supplemental fuel. TDF has a higher heating value than hog fuel making it a good candidate to replace current fossil fuels used in the boiler. The sulphur content is higher than hog fuel but co-combustion of both these usually results in absorption of much of the sulphur dioxide into the boiler ash.

Parameter	Tire Derived Fuel	Hog Fuel
Heating value (KJ/kg)	36,023	20,705
Carbon %	83.9	52.3
Hydrogen %	7.1	6.3
Oxygen %	2.2	40.5
Nitrogen %	0.24	0.10
Ash %	4.78	0.8
Moisture %	0.62	50-60
NaCl %	0.0	0.2-1.0

### 5.3 Proposed Crofton TDF Trial Method

TDF will be tested in the power boiler at three different application rates to help identify any impact on the boiler operations and emissions quality. Application rate will range from 0% to 10% by weight of hog fuel. TDF will be fed into the hog fuel system which delivers fuel to the boiler.

TDF Trial Schedule	
Schedule	Action
Phase 1	Set up and prove TDF metering equipment Run varying levels of TDF to assess feeding rates and boiler operational issues
Phase 2	Emissions test on increasing addition rates

Condition	Trial Number		
	1	2	3
TDF addition rate as % of hog feed	0%	5%	10%
Hog Fuel Salt Level	typical	typical	typical
Gas or Oil Auxiliary fuel	yes	yes	yes

A review of TDF trial monitoring requirements at NorskeCanada, Port Alberni and Powell River Divisions was conducted. Based on those experiences, we propose to monitor the emissions for discharge rate, total particulate, total metals, sulphur dioxide, carbon monoxide, oxygen, dioxins and furans, PAH's, and VOC's.

Air Emissions Testing	
Parameter	Frequency per trial
Particulate	one triplicate test
Flow Rate	one triplicate test
Temperature	one triplicate test
Moisture	one triplicate test
Oxygen	one triplicate test
SO <sub>2</sub>	one triplicate test
CO	Continuous emissions monitor
Trace metals (including Cr, Fe and Zn)	one triplicate test
Volatile Organic Compounds	Single Sample
PCDD, PCDF and PAH	Single Sample at 10% addition

Quantity and quality of the solid waste ash generated by the boiler will also be tested for the following parameters.

Solid Waste Testing under Each Condition	
Parameter	Frequency per variable
Ash sulphur content	One composite per trial
Ash carbon content	One composite per trial
ICP metal scan of ash	One composite per trial
LEP metals test	One composite per trial
PCDD, PCDF and PAH	Single composite at 10% addition

#### **5.4 Reporting on the TDF trial**

The mill will submit a formal written report to WLAP for the trials of coal, TDF, and railway ties upon completion of the trials and testing of the various samples.

## **6. Appendix 1 - #4 Power Boiler Specifics**

The Crofton No. 4 Power Boiler is a Foster Wheeler steam generator, in operation since 1978. The unit was originally designed to burn wood as the main fuel and oil as an auxiliary fuel. The original steam capacity of the boiler was 540,000 lb/hr when firing oil only, and 320,000 lb/hr when firing hog only. The auxiliary fuel has recently been changed to natural gas with oil as the backup only.

The furnace is 28'-4 ¼" deep by 28'-3 ½" wide. The furnace waterwalls are of membrane construction having 3" O.D. tubes on 4" centers. At elevation 255'-9", about half the rear waterwall forms a front screen ahead of the superheaters, while the rest forms a rear screen. The sloped section of the front screen is spaced on 8" centers while the vertical section consists of two staggered rows on 16" centers. The rear screen consists of one row on 8" centers. The rear screen was modified in 1986 by moving it away from the boiler bank such that the gas lanes were cleared allowing for better sootblower penetration.

The generating bank consists of 1992 tubes which are 2 ½" O.D. x 0.135" M.W.T. and 48 tubes which are 2 ½" O.D. x 0.150" M.W.T.. All tubes are swaged to 2.0" O.D. at both ends. All tubes are rolled into both the steam and mud drums. In addition all sidewall generating bank tubes are seal welded in both the steam and mud drum. Sidewall generating bank tubes are also finned and seal welded together to form a membrane wall.

The front half of the generating bank was replaced in 1986. The rear half of the generating bank is original.

The original primary superheater had 81 assemblies made of 2" diameter tubing at approximately 9" longitudinal spacing and 4" transverse spacing. It utilized a spaced design and consisted of three loops. This superheater was replaced in 1985 with a platen design consisting of 6 loops with a longitudinal spacing of 2 3/8". The total number of assemblies, transverse spacing and tube diameter remained the same. The superheater was replaced again in 1997 with similar design of reduced surface area.

The secondary superheater consists of 41 platens made up of both 2½" OD SA213T22 material. The platens each have two loops at the top and three loops at the bottom. All loops are hinge pinned together.

## 7. Appendix 2 - Quinsam Coal Analysis

CT&E Testing Corporation  
7500 76<sup>th</sup> STREET DELTA BRITISH COLUMBIA

### CERTIFICATE OF ANALYSIS

QUINSAM COAL CORPORATION  
P.O. Box 5000  
Hwy. 28. Kilometer 18 – Argonaut  
Campbell River BC V9W 5C5

September 14 2001

SAMPLE I.D. ASHGROVE BARGE  
2001  
Report No: 64-01795-1

DATE RECEIVED August 31.

Parameter	As received	Dry Basis	Air Dry Basis
Moisture (%)	7.23	na	3.23
Ash (%)	12.76	13.75	13.31
Volatile Matter (%)	34.32	36.99	35.80
Fixed Carbon (%)	46.69	49.26	47.66
Sulphur (%)	0.22	0.24	0.23
Calorific value (Btu/Lb)	11,160	12,030	11,641
Calorific value (Kcal/Kg gross)	6200	6683	6467

HARDGROVE GRINDABILITY INDEX (HGI) = 42

**CT&E Testing Corporation**  
7500 76<sup>th</sup> STREET DELTA BRITISH COLUMBIA

CERTIFICATE OF ANALYSIS  
QUINSAM COAL CORPORATION  
2001  
P.O. Box 5000  
Hwy. 28. Kilometer 18 – Argonaut  
Campbell River BC V9W 5C5

September 14

SAMPLE I.D. ASHGROVE BARGE

DATE RECEIVED August 31. 2001

Report No: 64-01795-1

TRACE ELEMENTS		RESULTS(DRY COAL BASIS)
Antimony	(Sb)	2 ?g/g
Arsenic	(As)	1 ?g/g
Barium	(Sa)	7 ?g/g
Beryllium	(Be)	<0.4 ?g/g
Boron	(B)	85 ?g/g
Bromide	(Br)	<20 ?g/g
Cadmium	(Cd)	<0.4 ?g/g
Chloride	(Cl)	221 ?g/g
Chromium	(Cr)	35 ?g/g
Cobalt	(Co)	26 ?g/g
Copper	(Cu)	38??g/g
Fluoride	(F)	30 ?g/g
Lead	(Pb)	<4 ?g/g
Lithium	(Li)	2 ?g/g
Magnesium	(Mg)	210 ?g/g
Manganese	(Mn)	74 ?g/g
Mercury	(Hg)	0.04 ?g/g
Molybdenum	(Mo)	<4 ?g/g
Nickel	(Ni)	27 ?g/g
Selenium	(Se)	<1 ?g/g
Silver	(Ag)	<0.4 ?g/g
Strontium	(Sr)	61 ?g/g
Thallium	(Ti)	<1 ?g/g
Tin	(Sn)	<1 ?g/g
Vanadium	(V)	79 ?g/g
Zinc	(Zn}	21 ?g/g
Zirconium	(Zr)	31 ?g/g

Procedure:

The sample was prepared according to ASTM. Volume 05.05, Method D 3683, The sample was analysed for trace elements by inductively coupled Plasma Emission Spectroscopy.

Bromide analysis by Ion Selective Electrode.

Chloride per ASTM Volume 05.05 Method D4208

Fluoride per ASTM Volume 05.05 Method D3761

Mercury was determined by Double Gold Amalgamation Gold Vapour Atomic Absorption

Results are reported in microgram per gram (?g/g ) on a dry basis.

## **8. Appendix 3 – Elk Falls Coal Trial Report**

## **9. Appendix 4 – TransCanada Power Railway Tie Trial Documentation**

## **10. Appendix 5 – Northwood’s Air Permit Section Covering Railway Ties**

## **11. Appendix 6 – Blandin Paper Railway Tie 1997 Testing Results**

## **12. Appendix 7 – Waste Railway Tie Chemical Characteristics**

## **13. Appendix 8 – Powell River Independent TDF Review**