Diane Roy
Director, Regulatory Affairs - Gas
FortisBC Energy Inc.

16705 Fraser Highway
Surrey, B.C. V4N 0E8
Tel: (604) 576-7349
Cell: (604) 908-2790
Fax: (604) 576-7074
Email: diane.roy@fortisbc.com
www.fortisbc.com

Regulatory Affairs Correspondence
Email: gas.regulatory.affairs@fortisbc.com

August 24, 2011

British Columbia Utilities Commission
Sixth Floor
900 Howe Street
Vancouver, B.C.
V6Z 2N3

Attention: Ms. Alanna Gillis, Acting Commission Secretary

Dear Ms. Gillis:

Re: FortisBC Energy Utilities[1] ("FEU") 2012 and 2013 Revenue Requirements and Natural Gas Rates Application

Response to the British Columbia Utilities Commission ("BCUC" or the "Commission") Information Request ("IR") No. 2 (Exhibit B-17)

Attachment 97.1

On May 4, 2011, the FEU filed the Application as referenced above. On August 19, 2011, in accordance with the amended Regulatory Timetable in Commission Order No. G-129-11, the FEU submitted their response to BCUC IR No. 2.

Attached please find Attachment 97.1 which is referred to in the response to BCUC IR 2.97.1, and was inadvertently omitted with the submission of Exhibit B-17.

If there are any questions regarding the attached, please contact the undersigned.

Yours very truly,

on behalf of the FORTISBC ENERGY UTILITIES

Original signed:

Diane Roy

Attachment

cc (e-mail only): Registered Parties

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[1] Comprised of FortisBC Energy Inc. ("FEI"), FortisBC Energy Inc. Fort Nelson Service Area ("Fort Nelson"), FortisBC Energy (Whistler) Inc. ("FEW"), and FortisBC Energy (Vancouver Island) Inc. ("FEVI")

PRAGMATHIC

Effluent energy recovery and dryers gas saving project
Review of the mill's project concept of May 20, 2010

Andrew,

Here are my comments on the proposed concept.

Based on the simulation results I obtain (updated with no LCR project), the specified L1/2 warm water exchanger heating temperature is higher than what is required to achieve your objectives, and the effluent flows indicated on the sketch appear a little bit low (you show 7500 l/min and I use 8200 l/min).

The table below summarizes the results.

No.	description	gas savings, GJ/hr		gas savings	net gas savings
		summer	winter	GJ/yr	k$/yr
1	**Scenario 1** Maximum use of existing dryers coils is obtained with no modification to the dryers; All glycol and steam coils are fully open on all dryers; All air bypass and cooling air heating are off on all dryers; The existing glycol heater using the reboiler steam is also open and receives any reboiler excess steam; Effluent HEX is replaced by a new one (named HEX2) with the same capacity; Old Blue is replaced by a new HEX1 and has 30% more capacity; L3 excess P2 pressate water is used for P1 bleaching chemicals; L3 fresh water used for P1 and P2 bleaching is replaced by HEX1 preheated water; Install reboiler clean steam pressure control on dryer 3 steam coils and/or reboiler steam glycol heater ***Effluent T: 43.0 deg. C summer, 47.1 deg. C winter*** HEX1 size ("Old Blue") estimated at 43 m2, HEX2 at 155 m2 X 2 ***With the LCR project, HEX area estimates were: HEX1 50m2, HEX2 2X 156 m2***	8.80	9.90	70686	726
2	**Scenario 2** Enough steam is available to use the glycol heater to its full capacity of 4300 kg/hr in winter conditions ***Effluent T: 40.6 deg. C summer, 44.2 deg. C winter*** HEX1 size ("Old Blue") estimated at 90 m2, HEX2 unchanged ***With the LCR project, HEX area estimates were: HEX1 101 m2, HEX2 2X 156 m2***	9.30	11.40	78246	804

Option 1

Two options are shown. The first option has a gas saving potential of 70700 GJ/yr and consists of the typical actions already presented in the past, updated with the corrected warm water balances (corrections made on the warm water temperature on February) and no low consistency refining project. With option 1, you recover enough heat to fully use the existing dryers' steam coils and glycol coils. To achieve this target, you need to heat L1/2 warm water to 52 deg. C (as shown on the sketch) and L3 warm water to 35 deg. C (here you heat more water than actually to supply the L3 bleaching needs, thus more energy is recovered despite the same water temperature than the current operation).

Option 2

You can further maximize the savings by generating enough reboiler's excess steam to use the existing glycol heater to its maximum capacity. This option 2 has a saving potential of 78200 GJ/yr and you fully use all existing equipment to maximize the savings without any modification to the dryers coils. The additional amount of savings obtained is rather small since the steam sent to the existing glycol heater has a low recovery efficiency. This is because, if you remember, the reboiler steam will displace some of the atmospheric steam actually used to heat the glycol. With option 2, you need to heat L3 warm water at 46 deg. C. This option is interesting because it opens the door to more options for the future. First, on the economic standpoint, the cost of the additional exchanger area should have a good marginal payback estimated at 2 yrs. Second, you have 4300 kg/hr of reboiler steam available (the steam sent to the glycol heater) that can be used in a more efficient way if you ever decide to bring more efficient changes to the existing dryers steam coils as proposed in the past (like replacing the glycol coils by steam coils). Furthermore, the sizes of the HEX obtained should be enough to perform well if you ever decide to implement LCR on lines 1/2. With the LCR project, the estimated required area were 101 m2 for HEX1 (Old Blue) and 2x156 m2 for HEX 2 (effluents hex). For this option 2, the area required are 90 m2 for HEX1 (Old Blue) and the same value for HEX2. The difference is small. If you include some safety margin in your specifications (I usually use +15% on the flows but you know better than me the actual fluctuations met in your process), these exchangers will likely have the required capacity if a LCR project is ever implemented later on L1/2.

For option 2, the final combined effluent T obtained is 41 deg. C, which is lower than the 43 deg. C obtained with option 1. This is another advantage.

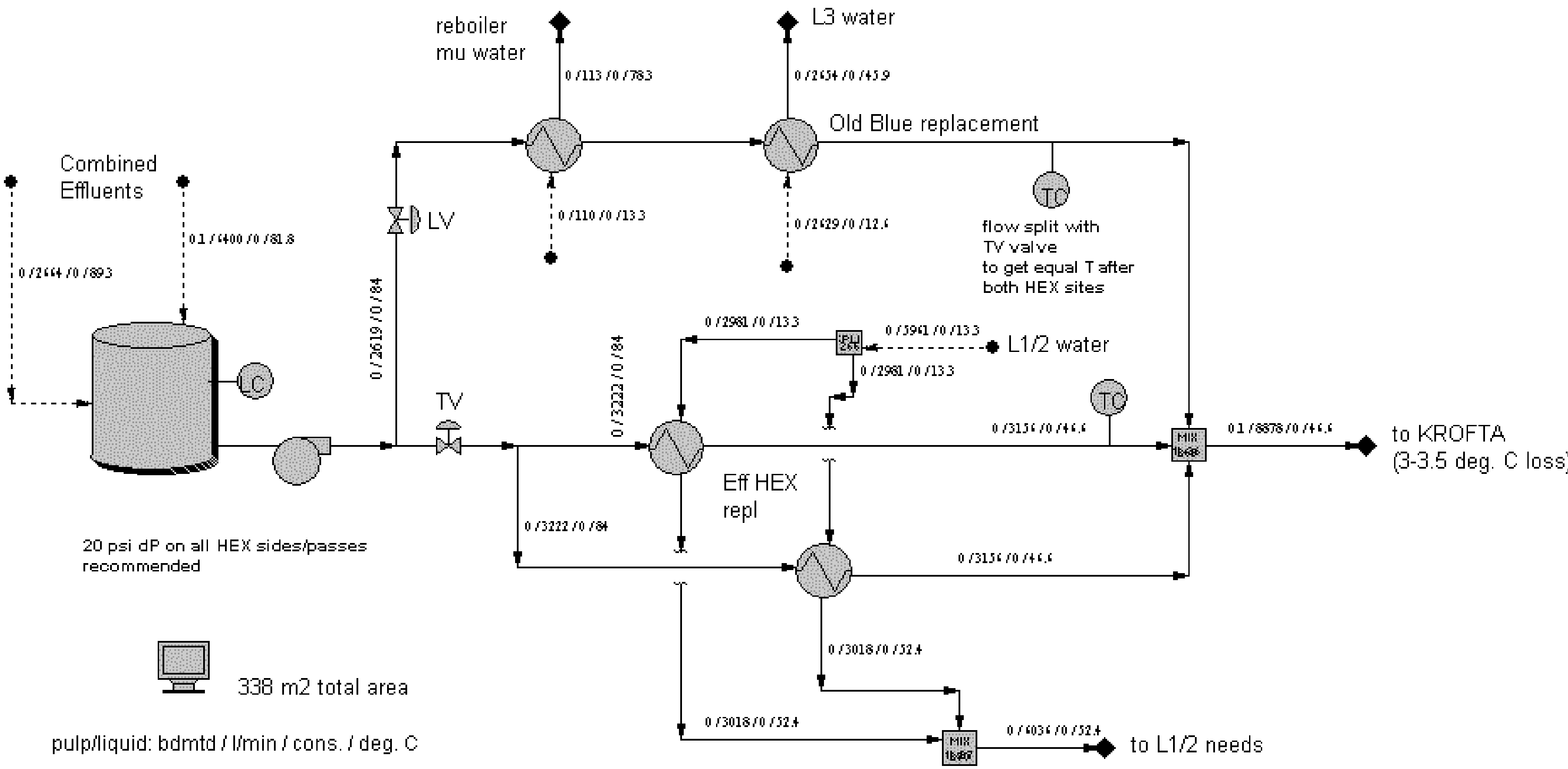
If you further increase the warm water preheating T with larger exchangers, you won't have users for the additional heat recovered and you will exhaust more steam to the atmosphere. It will be an energy displacement where you take more energy from the effluent and loose more steam energy. It could however be a good alternative if you plan to modify/add steam coils to the dryers as already examined in the past, but on the short term, you would not get any payback from the additional expense.

In any case, if some extra capacity must be added with a LCR project, it will be needed for the L3 warm water production. You will need to install a new exchanger in series with the existing one, the overall pressure drop will increase significantly and you will likely need to replace some pumps on the effluent and/or fresh water sides.

The following figures, based on option 2, show you the recommended specifications for your project. I have used a setup similar to your sketch to ease your evaluation. I also show some suggestions for the control of the network. The basic idea is to maintain the same cooled effluent T after their exchangers. This will minimize their overall sizes and costs and will maximize their energy recovery in operation. For your design, I suggest you add a safety factor to the flows, at least +10%. Please remember that the simulation takes into account the impact of the many modifications that compose option 2, and the temperatures and flows obtained will differ from the current operations. Using the “current operation” base case simulation results already sent in the past will help you see the difference and allow you to check if the base case figures were still a good representation of your current operations.

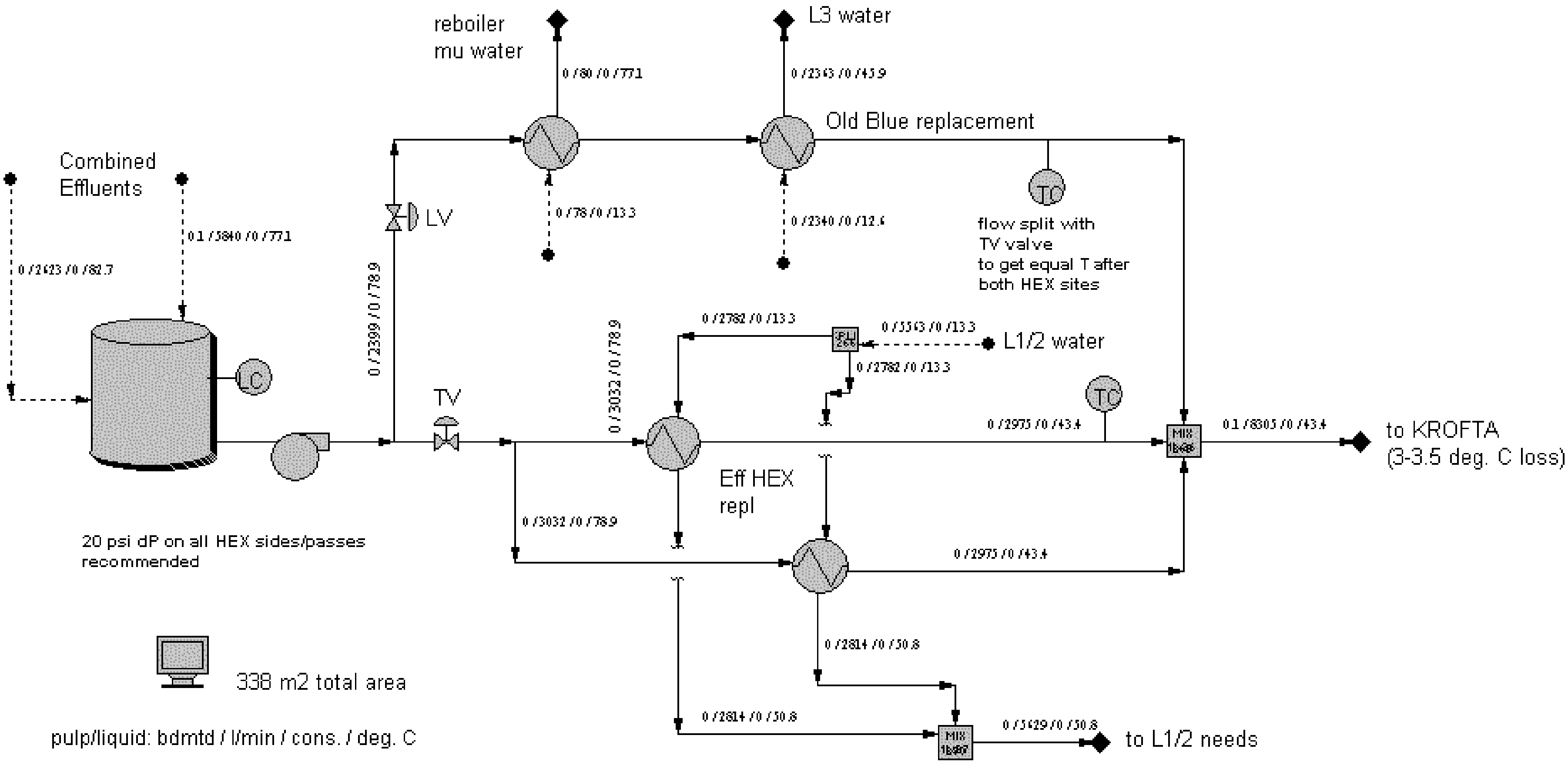
Finally, a general comment. Any increase of the specified dP across the HEX would be very beneficial to reduce their size, cost and fouling rate. You can increase the impeller size of the existing pumps or calculate the allowable pressure drop using a higher design opening of a control valve (ex. 75% instead of 50%), or install an ASD that would likely have a good payback with some financial help from BC Hydro.

Gaétan Noël, M.Sc.Eng.
Pragmathic Inc.



OPTION 2 - WINTER CONDITIONS

PRAGMATHIC



OPTION 2 - SUMMER CONDITIONS

Cold Medium	Tin =	13 degC		
	Tout =	38 degC		
	Flow Rate =	7,800 LPM =	468 m3/h	
Hot Medium	Tin =	84 degC		
	Tout =	55 degC		
	Flow Rate =	8,500 LPM =	510 m3/h	

Proposed (per explained on the E-mail Message)

	L 1/2 Water		L 3 Water	
Cold Medium	Tin =	13 degC	Tin =	13 degC
	Tout =	55.0 degC	Tout =	38.0 degC
	Flow Rate =	4,500 LPM	Flow Rate =	3,300 LPM
		270 m3/h		198 m3/h
Hot Medium	Tin =	84 degC	Tin =	84 degC
	Tout =	40.8 degC	Tout =	38.7 degC
	Flow Rate =	5,000 LPM	Flow Rate =	3,500 LPM
		300 m3/h		210 m3/h
			Effluent Discharge Temperature =	40 degC

Proposed (per explained on the report by Pragmathic)

	L 1/2 Water		L 3 Water	
Cold Medium	Tin =	13 degC	Tin =	13 degC
	Tout =	52.0 degC	Tout =	35.0 degC
	Flow Rate =	4,500 LPM	Flow Rate =	3,300 LPM
		270 m3/h		198 m3/h
Hot Medium	Tin =	84 degC	Tin =	84 degC
	Tout =	43.9 degC	Tout =	60.4 degC
	Flow Rate =	5,000 LPM	Flow Rate =	3,500 LPM
		300 m3/h		210 m3/h
			Effluent Discharge Temperature =	51 degC

EXISTING

Veffluent = 510 m3/h | Teffluent 1 = 84.0 degC | Teffluent 1 = 357.2 degK | ρ effluent 1 = 1,035 kg/m3 | Cp effluent 1 = 3.528 kJ/kgK

EFFLUENT — ρave = 1,045 / 1,045 kg/m3; Cpave = 3.477 / 3.477 kJ/kgK; OK

SHELL & TUBE HEX — Qavailable = -13,786 kW; Qactual = -13,786 kW

Veffluent = 510 m3/h | Teffluent 2 = 57.2 degC | Teffluent 2 = 330.4 degK | ρ effluent 2 = 1,054 kg/m3 | Cp effluent 2 = 3.425 kJ/kgK

M water = 464,278 kg/h | V water = 468.0 m3/h | T water 2 = 38.6 degC | T2 water 2 = 311.8 degK | ρ water 2 = 992 kg/m3 | Cp water 2 = 4.168 kJ/kgK

WATER — ρave = 996 / 996 kg/m3; Cpave = 4.154 / 4.154 kJ/kgK; OK

M water = 467,543 kg/h | V water = 468.0 m3/h | T water 1 = 13.0 degC | T2 water 1 = 286.2 degK | ρ water 1 = 999 kg/m3 | Cp water 1 = 4.141 kJ/kgK

52 wks/yr; 7 days/wk; 24 hr/day
Annual Hours of Operation = 8,736 hrs/yr
Energy TRANSFERRED = 433,572 GJ/yr

PROPOSED

per explained on the E-mail Message

L 1/2 Water

Veffluent = 300.0 m3/h | Teffluent 1 = 84.0 degC | Teffluent 1 = 357.2 degK | ρ effluent 1 = 1,035 kg/m3 | Cp effluent 1 = 3.528 kJ/kgK

EFFLUENT — ρave = 1,049 / 1,049 kg/m3; Cpave = 3.445 / 3.445 kJ/kgK; OK

MAKE-UP WATER HEX - HT — Qavailable = -13,017 kW; Qactual = -13,017 kW

Veffluent = 300 m3/h | Teffluent 2 = 40.8 degC | Teffluent 2 = 313.9 degK | ρ effluent 2 = 1,063 kg/m3 | Cp effluent 2 = 3.361 kJ/kgK

M water = 266,128 kg/h | V water = 270.0 m3/h | T water 2 = 55.0 degC | T2 water 2 = 328.2 degK | ρ water 2 = 986 kg/m3 | Cp water 2 = 4.188 kJ/kgK

WATER — ρave = 992 / 992 kg/m3; Cpave = 4.164 / 4.164 kJ/kgK; OK

M water = 269,736 kg/h | V water = 270.0 m3/h | T water 1 = 13.0 degC | T2 water 1 = 286.2 degK | ρ water 1 = 999 kg/m3 | Cp water 1 = 4.141 kJ/kgK

52 wks/yr; 7 days/wk; 24 hr/day
Annual Hours of Operation = 8,736 hrs/yr
Energy TRANSFERRED = 409,367 GJ/yr

L 3 Water

Veffluent = 210.0 m3/h | Teffluent 1 = 84.0 degC | Teffluent 1 = 357.2 degK | ρ effluent 1 = 1,035 kg/m3 | Cp effluent 1 = 3.528 kJ/kgK

EFFLUENT — ρave = 1,050 / 1,050 kg/m3; Cpave = 3.441 / 3.441 kJ/kgK; OK

MAKE-UP WATER HEX - HT — Qavailable = -9,555 kW; Qactual = -9,555 kW

Veffluent = 210.0 m3/h | Teffluent 2 = 38.7 degC | Teffluent 2 = 311.8 degK | ρ effluent 2 = 1,064 kg/m3 | Cp effluent 2 = 3.353 kJ/kgK

M water = 195,157 kg/h | V water = 198.0 m3/h | T water 2 = 55.0 degC | T2 water 2 = 328.2 degK | ρ water 2 = 986 kg/m3 | Cp water 2 = 4.188 kJ/kgK

WATER — ρave = 992 / 992 kg/m3; Cpave = 4.164 / 4.164 kJ/kgK; OK

M water = 197,807 kg/h | V water = 198.0 m3/h | T water 1 = 13.0 degC | T2 water 1 = 286.2 degK | ρ water 1 = 999 kg/m3 | Cp water 1 = 4.141 kJ/kgK

52 wks/yr; 7 days/wk; 24 hr/day
Annual Hours of Operation = 8,736 hrs/yr
Energy TRANSFERRED = 300,492 GJ/yr

PROPOSED

per explained on the report by Pragmathic

L 1/2 Water

Veffluent = 300.0 m3/h | Teffluent 1 = 84.0 degC | Teffluent 1 = 357.2 degK | ρ effluent 1 = 1,035 kg/m3 | Cp effluent 1 = 3.528 kJ/kgK

EFFLUENT — ρave = 1,048 / 1,048 kg/m3; Cpave = 3.451 / 3.451 kJ/kgK; OK

MAKE-UP WATER HEX - HT — Qavailable = -12,094 kW; Qactual = -12,094 kW

Veffluent = 300.0 m3/h | Teffluent 2 = 43.9 degC | Teffluent 2 = 317.0 degK | ρ effluent 2 = 1,062 kg/m3 | Cp effluent 2 = 3.373 kJ/kgK

M water = 266,476 kg/h | V water = 270.0 m3/h | T water 2 = 52.0 degC | T2 water 2 = 325.2 degK | ρ water 2 = 987 kg/m3 | Cp water 2 = 4.184 kJ/kgK

WATER — ρave = 993 / 993 kg/m3; Cpave = 4.162 / 4.162 kJ/kgK; OK

M water = 269,736 kg/h | V water = 270.0 m3/h | T water 1 = 13.0 degC | T2 water 1 = 286.2 degK | ρ water 1 = 999 kg/m3 | Cp water 1 = 4.141 kJ/kgK

52 wks/yr; 7 days/wk; 24 hr/day
Annual Hours of Operation = 8,736 hrs/yr
Energy TRANSFERRED = 380,367 GJ/yr

L 3 Water

Veffluent = 210.0 m3/h | Teffluent 1 = 84.0 degC | Teffluent 1 = 357.2 degK | ρ effluent 1 = 1,035 kg/m3 | Cp effluent 1 = 3.528 kJ/kgK

EFFLUENT — ρave = 1,044 / 1,044 kg/m3; Cpave = 3.483 / 3.483 kJ/kgK; OK

MAKE-UP WATER HEX - HT — Qavailable = -5,005 kW; Qactual = -5,005 kW

Veffluent = 210.0 m3/h | Teffluent 2 = 60.4 degC | Teffluent 2 = 333.5 degK | ρ effluent 2 = 1,052 kg/m3 | Cp effluent 2 = 3.437 kJ/kgK

M water = 196,663 kg/h | V water = 198.0 m3/h | T water 2 = 35.0 degC | T2 water 2 = 308.2 degK | ρ water 2 = 993 kg/m3 | Cp water 2 = 4.164 kJ/kgK

WATER — ρave = 996 / 996 kg/m3; Cpave = 4.152 / 4.152 kJ/kgK; OK

M water = 197,807 kg/h | V water = 198.0 m3/h | T water 1 = 13.0 degC | T2 water 1 = 286.2 degK | ρ water 1 = 999 kg/m3 | Cp water 1 = 4.141 kJ/kgK

52 wks/yr; 7 days/wk; 24 hr/day
Annual Hours of Operation = 8,736 hrs/yr
Energy TRANSFERRED = 157,401 GJ/yr

	Existing	Proposed (E-mail)	Proposed (Pragmathic)
Total Energy RECOVERED =	433,572 GJ/yr	709,859 GJ/yr	537,767 GJ/yr

Effluent prior to discharging

Existing

Veffluent = 510 m3/h | Teffluent 1 = 32.5 degC | Teffluent 1 = 305.7 degK | ρ effluent 1 = 1,067 kg/m3 | Cp effluent 1 = 3.329 kJ/kgK

EFFLUENT — ρave = 1,061 / 1,061 kg/m3; Cpave = 3.377 / 3.377 kJ/kgK; OK; Qavailable = 12,536 kW; 12,536

Veffluent = 510 m3/h | Teffluent 2 = 57.2 degC 0.0 | Teffluent 2 = 330.4 degK | ρ effluent 2 = 1,054 kg/m3 | Cp effluent 2 = 3.425 kJ/kgK

Energy to be Removed from Effluent prior to Discharging = 394,250 GJ/yr

Proposed (E-mail)

Veffluent = 570 m3/h | Teffluent 1 = 32.5 degC | Teffluent 1 = 305.7 degK | ρ effluent 1 = 1,067 kg/m3 | Cp effluent 1 = 3.329 kJ/kgK

EFFLUENT — ρave = 1,066 / 1,066 kg/m3; Cpave = 3.344 / 3.344 kJ/kgK; OK; Qavailable = 4,181 kW; 4,181

Veffluent = 570 m3/h | Teffluent 2 = 39.9 degC 0.0 | Teffluent 2 = 313.1 degK | ρ effluent 2 = 1,064 kg/m3 | Cp effluent 2 = 3.358 kJ/kgK

Energy to be Removed from Effluent prior to Discharging = 131,493 GJ/yr

Proposed (Pragmathic)

Veffluent = 570 m3/h | Teffluent 1 = 32.5 degC | Teffluent 1 = 305.7 degK | ρ effluent 1 = 1,067 kg/m3 | Cp effluent 1 = 3.329 kJ/kgK

EFFLUENT — ρave = 1,063 / 1,063 kg/m3; Cpave = 3.365 / 3.365 kJ/kgK; OK; Qavailable = 10,293 kW; 10,293

Veffluent = 570 m3/h | Teffluent 2 = 50.7 degC 0.0 | Teffluent 2 = 323.8 degK | ρ effluent 2 = 1,058 kg/m3 | Cp effluent 2 = 3.400 kJ/kgK

Energy to be Removed from Effluent prior to Discharging = 323,701 GJ/yr

Some common used thermal properties for water:

Density at 4 ^oC - 1,000 kg/m^3
Freezing temperature - 0 ^oC
Boiling temperature - 100 ^oC
Latent heat of melting - 334 kJ/kg
Latent heat of evaporation - 2,270 kJ/kg
Critical temperature - 380 - 386 ^oC
Critical pressure - 23.520 kN/m^2
Specific heat capacity water - 4.187 kJ/kgK
Specific heat capacity ice - 2.108 kJ/kgK
Specific heat capacity water vapor - 1.996 kJ/kgK
Thermal expansion from 4 ^oC to 100 ^oC - 4.2x10^{-2}

Thermal properties of water:

Temperature	Absolute Pressure	Density	Specific Volume	Specific Heat	Specific Entrophy	Dynamic Viscosity	Kinematic Viscosity	Expansion Coefficient	Specific Enthalpy	Prantl's no
deg C	kN/m2	kg/m3	m3/kg x 10-3	(kJ/kgK)	(kJ/kgK)	(Centipoise)	(m2/s)x106	x103 (l/K)	(kJ/kg)	
0	0.60	1000	100	4.217	0.000	1.780	1.792	-0.07	0.0	13.67
5	0.90	1000	100	4.204	0.075	1.520			21.0	
10	1.20	1000	100	4.193	0.150	1.310	1.304	0.088	41.9	9.47
15	1.70	999	100	4.186	0.223	1.140			62.9	
20	2.30	998	100	4.182	0.296	1.000	1.004	0.207	83.8	7.01
25	3.20	997	100	4.181	0.367	0.890			104.8	
30	4.30	996	100	4.179	0.438	0.798	0.801	0.303	125.7	5.43
35	5.60	994	101	4.178	0.505	0.719			146.7	
40	7.70	991	101	4.179	0.581	0.653	0.658	0.385	167.6	4.34
45	9.60	990	101	4.181	0.637	0.596			188.6	
50	12.50	988	101	4.182	0.707	0.547	0.553	0.457	209.6	3.56
55	15.70	986	101	4.183	0.767	0.504			230.5	
60	20.00	980	102	4.185	0.832	0.467	0.474	0.523	251.5	2.99
65	25.00	979	102	4.188	0.893	0.434			272.4	
70	31.30	978	102	4.190	0.966	0.404	0.413	0.585	293.4	2.56
75	38.60	975	103	4.194	1.016	0.378			314.3	
80	47.50	971	103	4.197	1.076	0.355	0.365	0.643	335.3	2.23
85	57.80	969	103	4.203	1.134	0.334			356.2	
90	70.00	962	104	4.205	1.192	0.314	0.326	0.698	377.2	1.96
95	84.50	962	104	4.213	1.250	0.297			398.1	
100	101.33	962	104	4.216	1.307	0.281	0.295	0.752	419.1	1.75
105	121.00	955	105	4.226	1.382	0.267			440.2	
110	143.00	951	105	4.233	1.418	0.253			461.3	
115	169.00	947	106	4.240	1.473	0.241			482.5	
120	199.00	943	106	4.240	1.527	0.230	0.249	0.86	503.7	1.45
		941.320		**4.246**						
125	228.00	939	106	4.254	1.565	0.221			524.3	
130	270.00	935	107	4.270	1.635	0.212			546.3	
135	313.00	931	107	4.280	1.687	0.204			567.7	
140	361.00	926	108	4.290	1.739	0.196	0.215	0.975	588.7	1.25
		924.320		**4.294**					**597.646**	
145	416.00	922	108	4.300	1.790	0.190			610.0	
150	477.00	918	109	4.310	1.842	0.185			631.8	
155	543.00	912	110	4.335	1.892	0.180			653.8	
160	618.00	907	110	4.350	1.942	0.174	0.189	1.098	674.5	1.09
		904.000		**4.358**						
165	701.00	902	111	4.364	1.992	0.169			697.3	
170	792.00	897	111	4.380	2.041	0.163			718.1	
175	890.00	893	112	4.389	2.090	0.158			739.8	
180	1,000.00	887	113	4.420	2.138	0.153	0.17	1.233	763.1	0.98
185	1,120.00	882	113	4.444	2.187	0.149			785.3	
		879.600		**4.450**						
190	1,260.00	876	114	4.460	2.236	0.145			807.5	
195	1,400.00	870	115	4.404	2.282	0.141			829.9	
200	1,550.00	863	116	4.497	2.329	0.138	0.158	1.392	851.7	0.92
220							0.149	1.597		0.88
225	2,550.00	834	120	4.648	2.569	0.121			966.8	
240							0.142	1.862		0.87
250	3,990.00	800	125	4.867	2.797	0.110			1087.0	
260							0.137	2.21		0.87
275	5,950.00	756	132	5.202	3.022	0.097			1211.0	
300	8,600.00	714	140	5.769	3.256	0.090			1345.0	
325	12,130.00	654	153	6.861	3.501	0.079			1494.0	
350	16,540.00	575	174	10.100	3.781	0.065			1672.0	
360	18,680.00	526	190	14.600	3.921	0.058			1764.0	

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT

25-Aug-10
Accuracy: Grade 20
Revision: Final

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

Budget Item	Cost Code	Description	Man Hours	Direct Purchase	Contractor Purchase	Labour and Overhead	Grand Total CDN $
		DIRECT COSTS					
500 - 0		**CIVIL/STRUCTURAL**	154		$ 7,237	$ 9,074	$ 16,812
600 - 0		**MECHANICAL & EQUIPMENT**	86		$ 580	$ 8,179	$ 943,539
700 - 0		**PIPING**	3,627		$ 143,922	$ 234,575	$ 378,497
1000 - 0		**ELECTRICAL / INSTRUMENTATION**					$ 360,584
1300 - 0		**SCAFFOLDING**	2,000				$ 2,000
1400 - 0		**EQUIPMENT RENTALS**	2,100				$ 2,100
		INDIRECT COSTS					
1200 - 0		**SAFETY AND SUPPORT**					
1500 - 0		**SURVEYING**					
1600 - 0		**CONSUMABLES**					
1700 - 0		**NDE**					
1800 - 0		**SITE FACILITIES**					
1900 - 0		**ESCALATION**					
2000 - 0		**SITE CLEANUP**					
2100 - 0		**PERMITTING**					
2200 - 0		**ENVIRONMENTAL ASSESSMENT**					
2300 - 0		**FREIGHT**					
2400 - 0		**TEMPORARY CONSTRUCTION POWER**					

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT

25-Aug-10
Accuracy: Grade 20
Revision: Final

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

Budget Item	Cost Code	Description	Man Hours	Direct Purchase	Contractor Purchase	Labour and Overhead	Grand Total CDN $
2500 - 0		**TRAINING**					
2600 - 0		**QUALITY ASSURANCE/QUALITY CONTROL**					
2700 - 0		**PROJECT/CONSTRUCTION MANAGEMENT**					
100 - 0		**ENGINEERING**				$ 86,769	
		TOTAL DIRECT COSTS					$ 1,703,531
		TOTAL INDIRECT COSTS				$ 86,769	
		SUBTOTAL					**$ 1,790,300**
		CONTINGENCY (CIVIL, MECH, PIPING; 10%)	133,816				
		CONTINGENCY (E & I; 17.9%)	73,287				
		TOTAL PROJECT BUDGET					**$ 1,997,403**

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT

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File: 210121

ENGINEERING

Labour Rate	N/A	$/hour

Budget Item	Cost Code	Description	Direct Purchase	Contractor Purchase	Labor and Overhead	Grand Total CDN $
100 - 0		**ENGINEERING**				
100 - 1		Class 20 Engineering Estimate, Civil, Mechanical, Piping	$ 37,800	$ -	$ -	
2		Grade 20 Engineering Estimate, E & I	$ 48,969			
		TOTAL ENGINEERING COSTS	**$ 86,769**	**$ -**	**$ -**	**$ 86,769**

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT
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CIVIL/STRUCTURAL

Labour Rate	**50.00**	**$/hour**

Cost Code	Description	Quantity	Units	Labour (Hrs/unit)	Total Lbr Hours	Labour rate ($/Unit)	Total Labour $ Cost	Materials ($/Unit)	Total Materials	Grand Total CDN $
							Inc 15% Productivity			
Structural Equipment										
1	**Spiral Heat Exchangers 631-325; 631-326**									
	Dimensions : 55" Dia. x 79" long									
	HX Pedestals (2)	2.5	m^3	20.000	50.00	$ 1,000	$ 2,875	$ 550	$ 1,375	$ 4,250
	Rebar 80 Kg/m3	200.0	kg	0.007	1.30	$ 0	$ 75	$ 4	$ 740	$ 815
	Anchor Bolts 3/4" diameter cast-in-place (16)	8.0	ea	0.400	3.20	$ 20	$ 184	$ 50	$ 400	$ 584
2	**Spiral Heat Exchangers 643-191; 643-192**									
	Dimensions : 58" Dia. x 99" long									
	HX Pedestals (2)	3.3	m^3	20.000	66.00	$ 1,000	$ 3,795	$ 550	$ 1,815	$ 5,610
	Rebar 80 Kg/m3	264.0	kg	0.007	1.72	$ 0	$ 99	$ 4	$ 977	$ 1,075
	Anchor Bolts 3/4" diameter cast-in-place (16)	8.0	ea	0.400	3.20	$ 20	$ 184	$ 50	$ 400	$ 584
3	**Pump 633-198**									
	Pump pad dimensions: 2400 x 860 x 600									
	Place and finish Concrete	1.1	m^3	20.000	22.00	$ 1,150	$ 1,455	$ 550	$ 605	$ 2,060
	Rebar 80 Kg/m3	88.0	kg	0.007	0.57	$ 0	$ 38	$ 4	$ 326	$ 363
	Anchor Bolts 3/4" diameter cast-in-place (16)	4.0	ea	0.400	1.60	$ 23	$ 106	$ 50	$ 200	$ 306
	Grout Pump Base	1.0	lot	4.000	4.00	$ 58	$ 265	$ 400	$ 400	$ 665
4	**Demolish Existing HEX Pads**	8.0	ea	8.000	64.00	$ -	$ -	$ -	$ -	$ -
	Remove debris	1.0	lot							$ 500
	TOTAL DIRECT COSTS				**$ 154**	**$ 3,272**	**$ 9,074**	**$ 2,211**	**$ 7,237**	**$ 16,812**

FRANSEN engineering | *think long term*

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
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ESTIMATE DETAIL REPORT
25-Aug-10
Accuracy: Grade 20
Revision: Final

MECHANICAL

Labour Rate	**65.00**	**$/hour**

Cost Code	Description	Quantity	Units	Labour (Hrs/unit)	Total Lbr Hours	Labour rate ($/Unit)	Total Labour $ Cost (Inc 15% Productivity)	Materials ($/Unit)	Total Materials	Grand Total CDN $
Mechanical Equipment										
1	**Spiral Heat Exchangers 631-325; 631-326**									
	Purchase Capital Equipment Package									$412,800
	Rig and lift heat exchangers onto bases	2.0	ea	4.000	8.00	$ 260	$ 598	$ -	$ -	$ 598
	Shim and level bases and bolt in place	2.0	ea	4.000	8.00	$ 260	$ 598	$ 10	$ 20	$ 618
	Build formwork and grout bases	2.0	ea	6.000	12.00	$ 390	$ 897	$ 100	$ 200	$ 1,097
2	**Spiral Heat Exchangers 643-191; 643-192**									
	Purchase Capital Equipment Package									$499,200
	Rig and lift heat exchangers onto bases	2.0	ea	4.000	8.00	$ 260	$ 598	$ -	$ -	$ 598
	Shim and level bases and bolt in place	2.0	ea	4.000	8.00	$ 260	$ 598	$ 10	$ 20	$ 618
	Build formwork and grout bases	2.0	ea	6.000	12.00	$ 390	$ 897	$ 100	$ 200	$ 1,097
3	**Pump 633-198**									
	Purchase Capital Equipment Package									$22,780
	Purchase motor for above (in elec package)									
	Purchace coupling for above	1	ea				$ 1,750			$ 1,750
	Rig and lift pump onto bases	1.0	ea	4.000	4.00	$ 260	$ 299	$ -	$ -	$ 299
	Shim and level base and bolt in place	1.0	ea	4.000	4.00	$ 260	$ 299	$ 10	$ 10	$ 309
	Build formwork and grout base	1.0	ea	4.000	4.00	$ 260	$ 299	$ 100	$ 100	$ 399
	Fit motor to pump	1.0	ea	2.000	2.00	$ 130	$ 150	$ -	$ -	$ 150
	Align motor and coupling	1.0	ea	4.000	4.00	$ 260	$ 299	$ 30	$ 30	$ 329
4	**Demolish AC Ducting and Blank Off**	1.0	lot	12.000	12.00	$ 780	$ 897		$ -	$ 897
	TOTAL DIRECT COSTS				**$ 86**	**$ 3,770**	**$ 8,179**	**$ 360**	**$ 580**	**$943,539**

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT

25-Aug-10
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Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

PIPING

Labour Rate 65.00 $/hour

Budget Item	Cost Code	Description	Size	Unit	Hours	Quantity	Unit	Total Hours	Unit Cost	Contractor Purchase	Labor and Overhead	Grand Total CDN $
		QRP Heat Exchanger										
633-196 to 643-191		Pipe 316Lss 11ga	250	mm	0.35	86	lf	30.1	85.00	$ 7,310	$ 1,957	$ 9,267
		Elbow 90Ø 316L 11ga	250	mm	0	7	ea	0	117.00	$ 819	$ -	$ 819
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	16	ea	0	95.00	$ 1,520	$ -	$ 1,520
		Bolt & Gasket Set	250	mm	1.68	16	ea	26.88	62.00	$ 992	$ 1,747	$ 2,739
		Supports	250	mm	4	1	lot	4	1,350.00	$ 1,350	$ 260	$ 1,610
		Valves gate	250	mm	5	2	ea	10	2,399.00	$ 4,798	$ 650	$ 5,448
		Valves check	250	mm	10	1	ea	10		$ -	$ 650	$ 650
		Weld Field	250	mm	9.6	30	ea	288			$ 18,720	$ 18,720
643-191 to 643-192		Pipe 316Lss 11ga	250	mm	0.35	86	lf	30.1	85.00	$ 7,310	$ 1,957	$ 9,267
		Elbow 90Ø 316L 11ga	250	mm	0	7	ea	0	117.00	$ 819	$ -	$ 819
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	7	ea	0	95.00	$ 665	$ -	$ 665
		Bolt & Gasket Set	250	mm	1.68	7	ea	11.76	62.00	$ 434	$ 764	$ 1,198
		Supports	250	mm	4	1	lot	4	1,350.00	$ 1,350	$ 260	$ 1,610
		Valves gate	250	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -
		Weld Field	250	mm	9.6	17	ea	163.2			$ 10,608	$ 10,608
643-192 to Tie in @ E51 & S52		Pipe 316Lss 11ga	250	mm	0.35	170	lf	59.5	85.00	$ 14,450	$ 3,868	$ 18,318
		Elbow 90Ø 316L 11ga	250	mm	0	10	ea	0	117.00	$ 1,170	$ -	$ 1,170
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	5	ea	0	95.00	$ 475	$ -	$ 475
		Bolt & Gasket Set	250	mm	1.68	5	ea	8.4	62.00	$ 310	$ 546	$ 856
		Supports	250	mm	4	3	lot	12	1,350.00	$ 4,050	$ 780	$ 4,830
		Valves gate	250	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -
		Weld Field	250	mm	9.6	31	ea	297.6			$ 19,344	$ 19,344
Tie in @ 691-181 to 633-195 (tank)		Pipe 316Lss 11ga	250	mm	0.35	48	lf	16.8	85.00	$ 4,080	$ 1,092	$ 5,172
		Elbow 90Ø 316L 11ga	250	mm	0	6	ea	0	117.00	$ 702	$ -	$ 702
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	4	ea	0	95.00	$ 380	$ -	$ 380
		Bolt & Gasket Set	250	mm	1.68	4	ea	6.72	62.00	$ 248	$ 437	$ 685
		Supports	250	mm	4	1	lot	4	1,350.00	$ 1,350	$ 260	$ 1,610
		Valves gate	250	mm	5	1	ea	5	2,399.00	$ 2,399	$ 325	$ 2,724
		Valves check	250	mm	10	1	ea	10		$ -	$ 650	$ 650
		Weld Field	250	mm	9.6	19	ea	182.4			$ 11,856	$ 11,856
693-181 to 633-195 (tank)		Pipe 316Lss 11ga	250	mm	0.35	138	lf	48.3	85.00	$ 11,730	$ 3,140	$ 14,870
		Elbow 90Ø 316L 11ga	250	mm	0	11	ea	0	117.00	$ 1,287	$ -	$ 1,287
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	4	ea	0	95.00	$ 380	$ -	$ 380
		Bolt & Gasket Set	250	mm	1.68	4	ea	6.72	62.00	$ 248	$ 437	$ 685
		Supports	250	mm	4	3	lot	12	1,350.00	$ 1,350	$ 780	$ 2,130
		Valves gate	250	mm	5	1	ea	5	2,399.00	$ 2,399	$ 325	$ 2,724
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -

FRANSEN engineering | *think long term*

ESTIMATE DETAIL REPORT

25-Aug-10
Accuracy: Grade 20
Revision: Final

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

PIPING

Labour Rate	65.00	$/hour

Budget Item	Cost Code	Description	Size	Unit	Hours	Quantity	Unit	Total Hours	Unit Cost	Contractor Purchase	Labor and Overhead	Grand Total CDN $
		Weld Field	250	mm	9.6	33	ea	316.8			$ 20,592	$ 20,592
Tie in @ 691-181 to 633-195 (tank)		Pipe 316Lss 11ga	250	mm	0.35	76	lf	26.6	85.00	$ 6,460	$ 1,729	$ 8,189
		Elbow 90Ø 316L 11ga	250	mm	0	6	ea	0	117.00	$ 702	$ -	$ 702
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	4	ea	0	95.00	$ 380	$ -	$ 380
		Bolt & Gasket Set	250	mm	1.68	4	ea	6.72	62.00	$ 248	$ 437	$ 685
		Supports	250	mm	4	2	lot	8	1,350.00	$ 2,700	$ 520	$ 3,220
		Valves gate	250	mm	5	1	ea	5	2,399.00	$ 2,399	$ 325	$ 2,724
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -
		Weld Field	250	mm	9.6	19	ea	182.4			$ 11,856	$ 11,856
Rotary Screens to 633-195 (tank)		Pipe 316Lss 11ga	250	mm	0.35	92	lf	32.2	85.00	$ 7,820	$ 2,093	$ 9,913
		Elbow 90Ø 316L 11ga	250	mm	0	6	ea	0	117.00	$ 702	$ -	$ 702
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	8	ea	0	95.00	$ 760	$ -	$ 760
		Bolt & Gasket Set	250	mm	1.68	8	ea	13.44	62.00	$ 496	$ 874	$ 1,370
		Supports	250	mm	4	2	lot	8	1,350.00	$ 2,700	$ 520	$ 3,220
		Valves gate	250	mm	5	2	ea	10	2,399.00	$ 4,798	$ 650	$ 5,448
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -
		Weld Field	250	mm	9.6	24	ea	230.4			$ 14,976	$ 14,976
Tie in @ 691-181 to 633-195 (tank)		Pipe 316Lss 11ga	250	mm	0.35	76	lf	26.6	85.00	$ 6,460	$ 1,729	$ 8,189
		Elbow 90Ø 316L 11ga	250	mm	0	6	ea	0	117.00	$ 702	$ -	$ 702
		Tee 90Ø 316L 11ga	250	mm	0	0	ea	0	155.00	$ -	$ -	$ -
		Flg 150# Vanstone T316 & MS B/U Flg	250	mm	0	4	ea	0	95.00	$ 380	$ -	$ 380
		Bolt & Gasket Set	250	mm	1.68	4	ea	6.72	62.00	$ 248	$ 437	$ 685
		Supports	250	mm	4	2	lot	8	1,350.00	$ 2,700	$ 520	$ 3,220
		Valves gate	250	mm	5	1	ea	5	2,399.00	$ 2,399	$ 325	$ 2,724
		Valves check	250	mm	10	0	ea	0		$ -	$ -	$ -
		Weld Field	250	mm	9.6	19	ea	182.4			$ 11,856	$ 11,856
633-198 to 271-140 tie in		Pipe 316L sch 10ss	200	mm	0.4	69	lf	21	39.75	$ 2,743	$ 1,794	$ 4,537
		Elbow 90Ø 316L sch 10ss	200	mm	0	9	ea	9	135.00	$ 1,215	$ -	$ 1,215
		Conc Reducer 8 x 6	200	mm	0	4	ea	0	135.00	$ 540	$ -	$ 540
		Flg 150# Vanstone 316L sch 10ss	200	mm	0	8	ea	0	63.00	$ 504	$ -	$ 504
		Bolt & Gasket Set	200	mm	3.36	8	ea	26.88	59.00	$ 472	$ 1,747	$ 2,219
		Supports	200	mm	50	2	lot	100	200.00	$ 400	$ 6,500	$ 6,900
		Valves gate	200	mm	5	3	ea	15	2,399.00	$ 7,197	$ 975	$ 8,172
		Valves check	200	mm	5	1	ea	5	2,399.00	$ 2,399	$ 325	$ 2,724
		Weld Field	200	mm	9.6	30	ea	288			$ 18,720	$ 18,720
271-140 to 631-325		Pipe 316L sch 10ss	200	mm	0.4	64	lf	21	39.75	$ 2,544	$ 1,664	$ 4,208
		Elbow 90Ø 316L sch 10ss	200	mm	0	7	ea	9	135.00	$ 945	$ -	$ 945
		Tee 316L sch 10ss	200	mm	0	0	ea	0	195.00	$ -	$ -	$ -
		Flg 150# Vanstone 316L sch 10ss	200	mm	0	0	ea	0	63.00	$ -	$ -	$ -
		Bolt & Gasket Set	200	mm	3.36	0	ea	0	59.00	$ -	$ -	$ -
		Supports	200	mm	50	2	lot	100	200.00	$ 400	$ 6,500	$ 6,900
		Valves gate	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Valves check	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Weld Field	200	mm	9.6	18	ea	172.8			$ 11,232	$ 11,232

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ESTIMATE DETAIL REPORT

25-Aug-10
Accuracy: Grade 20
Revision: Final

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

PIPING

Labour Rate 65.00 $/hour

Budget Item	Cost Code	Description	Size	Unit	Hours	Quantity	Unit	Total Hours	Unit Cost	Contractor Purchase	Labor and Overhead	Grand Total CDN $
631-325 to 631-326		Pipe 316L sch 10ss	200	mm	0.4	53	lf	21	39.75	$ 2,107	$ 1,378	$ 3,485
		Elbow 90Ø 316L sch 10ss	200	mm	0	6	ea	9	135.00	$ 810	$ -	$ 810
		Tee 316L sch 10ss	200	mm	0	0	ea	0	195.00	$ -	$ -	$ -
		Flg 150# Vanstone 316L sch 10ss	200	mm	0	0	ea	0	63.00	$ -	$ -	$ -
		Bolt & Gasket Set	200	mm	3.36	0	ea	0	59.00	$ -	$ -	$ -
		Supports	200	mm	50	2	lot	100	200.00	$ 400	$ 6,500	$ 6,900
		Valves gate	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Valves check	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Weld Field	200	mm	9.6	15	ea	144			$ 9,360	$ 9,360
631-326 to tie in @S50 & E54		Pipe 316L sch 10ss	200	mm	0.4	69	lf	21	39.75	$ 2,743	$ 1,794	$ 4,537
		Elbow 90Ø 316L sch 10ss	200	mm	0	5	ea	9	135.00	$ 675	$ -	$ 675
		Tee 316L sch 10ss	200	mm	0	0	ea	0	195.00	$ -	$ -	$ -
		Flg 150# Vanstone 316L sch 10ss	200	mm	0	0	ea	0	63.00	$ -	$ -	$ -
		Bolt & Gasket Set	200	mm	3.36	0	ea	0	59.00	$ -	$ -	$ -
		Supports	200	mm	50	2	lot	100	200.00	$ 400	$ 6,500	$ 6,900
		Valves gate	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Valves check	200	mm	5	0	ea	0	2,399.00	$ -	$ -	$ -
		Weld Field	200	mm	9.6	14	ea	134.4			$ 8,736	$ 8,736
		TOTAL DIRECT COSTS						**3,627**		**$ 143,922**	**$ 234,575**	**$ 378,497**

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

OTHER MISCELLANEOUS DIRECT COSTS

Labour Rate	75.93	$/hour

Budget Item	Cost Code	Description	Direct Purchase	Contractor Purchase	Labor and Overhead	Grand Total CDN $
1300 - 0		**SCAFFOLDING**				
		Mechanical scaffold			$ -	$ -
		Piping scaffold 1 lot	$ 2,000			$ 2,000
		Subtotal			**$ -**	**$ 2,000**
1400 - 0		**EQUIPMENT RENTALS**				
1400 - 1		Cranes & Mobile Equipment 1 lot	$ 1,600			$ 1,600
		Site transport mechanical 1 lot	$ 500			$ 500
		Piping rentals lot				$ -
		Temporary services lot				$ -
		Subtotal	**$ 2,100**			**$ 2,100**
		TOTAL MISC DIRECT COSTS	**$ 2,100**			**$ 4,100**
		TOTAL DIRECT COSTS	**$ 2,100**	**$ -**	**$ -**	**$ 4,100**

FRANSEN engineering | think long term

Client: Quesnel River Pulp Company
Project: Heat Exchanger Equipment & Piping Upgrade
File: 210121

ESTIMATE DETAIL REPORT
25-Aug-10
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INDIRECT COSTS

Labour Rate	$/hour

Budget Item	Cost Code	Description	Direct Purchase	Contractor Purchase	Labor and Overhead	Grand Total CDN $
1200 - 0		**SAFETY AND SUPPORT**				
1200 - 1		Misc Work, Confined Space and Safety Attendance				
		No allowance has been included				
1500 - 0		**SURVEYING**				
1500 - 1		Surveying lot hrs				
		No allowance has been included				
1600 - 0		**CONSUMABLES**				
1600 - 1		Consumables Factor (Allowance Percentage of Project Labour Cost)				
		No allowance has been included				
1700 - 0		**NDE**				
1700 - 1		X-Ray/Testing/Hydro				
		No allowance has been included				
1800 - 0		**SITE FACILITIES**				
1800 - 1		Washcar, portapotty, office, janitorial, lunchroom				
		No allowance has been included				
1900 - 0		**ESCALATION**				
1900 - 1		No allowance has been included				
2000 - 0		**SITE CLEANUP**				
2000 - 1		Included in trade discipline work				
2100 - 0		**PERMITTING**				
2100 - 1		No allowance has been included				
2200 - 0		**ENVIRONMENTAL ASSESSMENT**				
2200 - 1		No allowance has been included				
2300 - 0		**WATER QUALITY TESTING**				
2300 - 1		No allowance has been included				
2400 - 0		**FREIGHT**				
2400 - 1		Freight cost for items in estimate				
2500 - 0		**TEMPORARY CONSTRUCTION POWER**				
2500 - 1		No allowance has been included				
2600 - 0		**TRAINING**				
2600 - 1		No allowance has been included				
2700 - 0		**QUALITY ASSURANCE/QUALITY CONTROL**				
2700 - 1		No allowance has been included				
2800 - 0		**PROJECT/CONSTRUCTION MANAGEMENT**				

FRANSEN engineering | *think long term*

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ESTIMATE DETAIL REPORT
25-Aug-10
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Revision: Final

INDIRECT COSTS

Labour Rate	**$/hour**

Budget Item	Cost Code	Description	Direct Purchase	Contractor Purchase	Labor and Overhead	Grand Total CDN $
2800 - 1		No allowance has been included				

Combustion Emissions Report

Company Name: Sunrise Soya Foods
Site Name: Sunrise Soya Foods
Engineers Name: Jackie Ng

A Guide To This Product:

This program has been written by Autoflame to assist the combustion industry to reduce emissions and maximise fuel efficiency. The following guide is setout to assist the user in obtaining the best results from the program. This software program provides an Emissions and Fuel Consumption comparison between your existing combustion plant performance and combustion performance achievable with Autoflames combustion control technology.

The Analysis is performed in 5 easy screens:

Screen 1 - Enter Existing Burner Performance Data

Screen 1a - Analyse Existing Performance Data

Screen 2 - Enter Projected Burner Performance Data

Screen 2a - Analyse Projected Performance Data

Screen 3 - Savings. Results of existing and projected performance's are compared to provide numerical and graphical views of the reduction in harmful emissions and the reduction in fuel used together with corresponding cost savings.

This program is designed as an accurate assesment of potential savings. Like all calculations results are only as accurate as the accuracy of the data entered.

Data entry for each state has been broken down into a further 6 easy steps:

[Step 1] - Enter Details about your site. - These are used on the print out for record purposes.

[Step 2] - Enter Units and Ambient Conditions. - Data can be entered in either metric or imperial units. Ambient pressure is assumed to be 1 atmosphere, i.e. sea level, and the figure entered here is a deviation from that. At high altitude you will enter a negative value. Ambient conditions are used to adjust the indicated volumes of gases which are calculated from weight.

[Step 3] - Enter details about your fuel. - Fuel can vary in composition from different areas of supply. Default values have been entered based on Standard Specifications of Fuel Oils and Gas. The New Fuel button allows the user to input fuel data which is site specific. Maximum CO_2 produced at Stoichiometric combustion is calculated from the fuel data.

[Step 4] - Enter details about your burner. - Emissions are a function of the amount of fuel burnt not the capacity of the burner. We have therefore asked for the burner fuel consumption over a selectable period of time. The best results can be achieved by clocking the amount of fuel on a meter, whilst monitoring the exhaust gases and extrapolating the fuel usage to an hourly rate. Alternatively read your fuel bill and equate this to a period of time. The burner rating tells you the maximum fuel that the burner is capable of inputing into the system during one hour not the actual amount of fuel used

[Step 5] - Enter details about your Current/Proposed Combustion Performance. All the white boxes are for entered data, grey boxes are calculated data. Either O_2 or CO_2 can be entered, the corresponding value will be calculated.

For ease of calculation we are assuming this performance is maintained throughout the firing rate of the burner. However in reality restrictions of the combustion head design require varying amounts of excess air to maintain safe combustion. To obtain more accurate results three firing rates can be nominated e.g. high fire, 60% firing and low fire. Combustion tests can be taken at each of these rates along with fuel flow, extrapolated to a per hour flow, then a judgement made as to how many hours run at each firing rate. A saving at each firing rate can be established and totalised per annum.

Company Name: Sunrise Soya Foods
Site Name: Sunrise Soya Foods
Engineers Name: Jackie Ng

A Guide To This Product:

[Step 6] Enter details about your stack (optional) - this feature calculates the boiler exhaust velocity at the sampling point.

Analyse: the values entered are now analysed to produce results.

Emissions are expressed in weight and volume per unit of time or per unit of heat (MW / MMBtu). Combustion Efficiency is used to calculate heat losses giving the net useful heat into the system. The fuel consumption both instantaneous and totalised is shown with total cost.

Steps 1 to 6 and 'Analyse' are repeated for the projected performance.

Savings (per unit of time, hour, day, week, month, quarter, year) (User selectable options)

Reductions in Emissions

A table shows the reduction in both weight and volume.

A histogram shows a comparison in harmful emissions of CO_2, CO, NO and SO_2

Fuel Savings

Actual savings are shown in volume and cost with corresponding improvements in efficiency and a reduction in stack losses

The results show the benefits to be gained by improving the combustion performance of the burner. It is possible with the addition of the Autoflame Micro Modulation System to gain up to a further 7% saving in fuel consumption, and with the Exhaust Gas Analysis trim System up to a further 3% saving in fuel consumption. Tick the relevant box to see how these Autoflame Products contribute additional savings.

MM savings are achieved by:

Maintaining the commissioned fuel/air ratio with direct drive positioning motors controlled from infinitely repeatable stored positions within the microprocessor memory, an internal PID control for both hot water and steam applications achieving near locked-on setpoint control, eliminating over and under shoots to the required setpoint.

EGA savings are achieved by:

Once precise fuel/air ratio control has been achieved with the Autoflame MM System, the only variables outside the systems control are changes in barometric conditions and the fuel supply. The Exhaust Gas Analyser measures the products of combustion and trims the system back to commissioned values.

Further savings that are not quantifiable on a general basis are:

Reduced maintainance

Reduced downtime

Intelligent Boiler Sequencing

I.B.S. ensures that the minimum number of boiler/burner units are in operation at any one time to satisfy the heat requirement imposed upon the boiler plant, particularly in the case of multi-boiler installations.

MM & EGA saving estimates are based on data collected from hundreds of sites over the last 20 years. These percentages represent a minimum saving, actual savings often exceed these estimated benefits.

Independent tests were carried out by The Department of the Environment under the Energy Efficiency Best Practice Program, Good Practice Case Study 338

Company Name: Sunrise Soya Foods

Site Name: Sunrise Soya Foods

Engineers Name: Jackie Ng

A Guide To This Product:

Further information can be found on our Website: http://www.autoflame.com/

Data and references used:

Source:

North American Combustion Handbook, 3rd Edition Volume 1, Table 2.1a

Technical Data on Fuel 7th Edition, by JW Rose & JR Cooper, Ch. Fuels, published by the British National Committee of the World Energy Conference, 34 St. James's Street, London SW1A 11HD.

BS 2869 Fuel Oils. American National Standards Institute 'Standard Specifications of Fuel Oils', ASTM Designation D396-69

Other references:

Thermodynamics, An engineering Approach, Second Edition by Yunus A.Cengel & Michael A.Boles, published by McGraw-Hill, Inc. (ISBN 0-07-113249-X) Ch. 2-7, Table A1 & A2

Kaye & Laby Sixteenth Edition, Tables of Physical & Chemical Constants, published by Longman (ISBN 0-582-22629-5)

Energy Managers Workbook, Energy Publications (Cambridge) (ISBN 0-905332-22-9)

BS 845 Part 1: 1987

Constants:

1 ton (Short) = 2000 lb

Combined Gas Law: (Boyles Law & Charles Law)

$pV = mRT$

T = temp. °K,

p = pressure kPa,

V = volume m3

m = mass kg,

R = gas constant kJ/kg.K

K = °C + 273.15°K

Absolute Pressure P = Guage Pressure + 101.325 (1 atmosphere)

R:

N_2 - 0.2968

Air - 0.287

O_2 - 0.2598

CO - 0.2968

H_2O - 0.4615

SO_2 - 0.1298

CO_2 - 0.1889

Air Density @ Ambient Conditions = 1.22 kg/m³

Water Density @ Ambient Conditions = 1000 kg/m³

Combustion Emissions Report

AUTOFLAME

Visit http://www.autoflame.com/

Company Name: Sunrise Soya Foods
Site Name: Sunrise Soya Foods
Engineers Name: Jackie Ng

Analysis of Existing Performance Data

Ambient Conditions

Ambient Temperature: 92.00°F
Ambient Pressure: 0.00inhg

Fuel Composition

Fuel Type: Natural Gas (Pitsburgh PA)
Fuel State: Gas
Calorific Value @ ISC: 58.13 Mj/kg
Specific Gravity 0.63

Breakdown By Weight

C	H	S	N	O	W
75.70%	23.50%	0.00%	0.80%	0.00%	0.00%

Max CO2 Produced at Stoichoimetric Combustion 12.09%

Fuel Used

Fuel Used 4199.99999 ft³ / hour
Unit Fuel Cost $0.00878 / ft³

Exhaust Readings

Exhaust Temperature 478.00°F
Exhaust Delta T 386.00°F
O2 Reading 4.10%
CO2 Reading 9.73%
CO Reading 0.00ppm
NO Reading 0.00ppm
Net Efficiency 82.10% Gross Efficiency 92.43%

Combustion Emissions Report

AUTOFLAME

Visit http://www.autoflame.com/

Company Name: Sunrise Soya Foods
Site Name: Sunrise Soya Foods
Engineers Name: Jackie Ng

Analyses of Existing Performance Data
Emissions per year

	Weight in lb	Volume in ft³
Oxygen (O2)	835.11Tons	21025574.62
Carbon Dioxide (CO2)	2451.33Tons	44874463.46
Carbon Monoxide (CO)	0.00	0.00
Nitrous Oxide (NO)	0.00	0.00
Sulphur Dioxide (SO2)	0.00	0.00
Water (H2O)	1868.89Tons	83583864.29
Nitrogen (N2)	14092.20Tons	405330172.66
Total Emissions from Boiler	19247.53Tons	554814080.55

Net Efficiency	82.10%
Gross Efficiency	92.43%
Delta T	366.00°F

Heat Input Into Boiler (Output from Burner)	5.04MMBtu/hour
Max Heat Loss To Stack (inc Standing Losses Of 0.25% Of Fuel Input)	0.91MMBtu/hour
Net Useful Heat Output From Boiler	4.12MMBtu/hour
Fuel Flow Per Hour	4200.00000 ft³
Total Fuel Used	36792000.00 ft³
Fuel Cost	$359060.47

Combustion Emissions Report

AUTOFLAME

Visit http://www.autoflame.com/

Company Name:	Sunrise Soya Foods
Site Name:	Sunrise Soya Foods
Engineers Name:	Jackie Ng

Analysis of Projected Performance Data

Ambient Conditions

Ambient Temperature:	92.00°F
Ambient Pressure:	0.00inhg

Fuel Composition

Fuel Type:	Natural Gas (Pitsburgh PA)
Fuel State:	Gas
Calorific Value @ ISC:	58.13 Mj/kg
Specific Gravity	0.63

Breakdown By Weight

C	H	S	N	O	W
75.70%	23.50%	0.00%	0.80%	0.00%	0.00%

Max CO2 Produced at Stoicholmetric Combustion	12.09%

Fuel Used

Fuel Used	4064.62337 ft³ / hour
Unit Fuel Cost	$0.00976 / ft³

Exhaust Readings

Exhaust Temperature	475.30°F	**(Projected Temp)**	
Exhaust Delta T	[illegible]		
O2 Reading	3.80%		
CO2 Reading	9.90%		
CO Reading	0.00ppm		
NO Reading	0.00ppm		
Net Efficiency	[illegible]	Gross Efficiency	92.61%

Combustion Emissions Report

AUTOFLAME

Visit http://www.autoflame.com/

Company Name: Sunrise Soya Foods

Site Name: Sunrise Soya Foods

Engineers Name: Jackie Ng

Analysis of Projected Performance Data

Emissions per year

	Weight in lb	Volume in ft³
Oxygen (O_2)	735.99Tons	18530063.04
Carbon Dioxide (CO_2)	2372.31Tons	43428043.28
Carbon Monoxide (CO)	0.00	0.00
Nitrous Oxide (NO)	0.00	0.00
Sulphur Dioxide (SO_2)	0.00	0.00
Water (H_2O)	1808.65Tons	80889745.57
Nitrogen (N_2)	13400.22Tons	385426967.33
Total Emissions from Boiler	18317.18Tons	528274815.93

Net Efficiency	82.29%
Gross Efficiency	92.61%
Delta T	383.30°F

Heat Input Into Boiler (Output from Burner)	5.02MMBtu/hour
Max Heat Loss To Stack (inc Standing Losses Of 0.25% Of Fuel Input)	0.90MMBtu/hour
Net Useful Heat Output From Boiler	4.12MMBtu/hour
Fuel Flow Per Hour	4064.62329 ft³
Total Fuel Used	35606100.00 ft³
Fuel Cost	$347487.04

Combustion Emissions Report

AUTOFLAME

Visit http://www.autoflame.com/

Company Name: Sunrise Soya Foods
Site Name: Sunrise Soya Foods
Engineers Name: Jackie Ng

Projected Savings - Screen 3

Savings In Emissions

	Weight in lb	Volume in ft³	% Saving
Oxygen (O_2)	98.12Tons	2495511.02	11.87%
Carbon Dioxide (CO_2)	79.01Tons	1446421.19	3.22%
Carbon Monoxide (CO)	0.00	0.00	0.00%
Nitrous Oxide (NO)	0.00	0.00	0.00%
Sulphur Dioxide (SO_2)	0.00	0.00	0.00%
Water (H_2O)	60.24Tons	2694119.51	3.22%
Nitrogen (N_2)	691.98Tons	19903194.39	4.91%
Total Emissions from Boiler	930.35Tons	26539270.79	

n.b. 1 ton (Short) = 2000lb

Savings In Emissions: 4.78%

Efficiency Improvement (Net)	0.19%
Efficiency Improvement (Gross)	0.18%
Exhaust Delta T Improvement	2.70°F
Savings in Heat Loss to Stack	0.01MMBtu/hour

Savings in Fuel Used	1185899.97 ft³
Fuel Savings (Money)	$11573.43

Include M.M. Saving 3.0%

Include E.G.A. Saving 1.0%

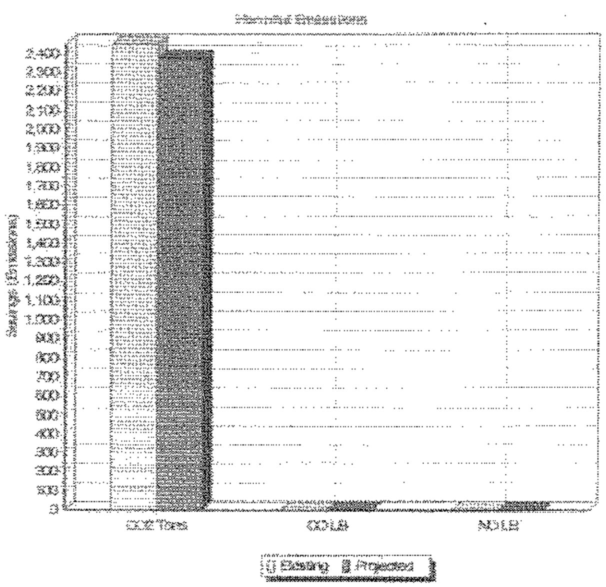
Savings in Fuel: 3.22%

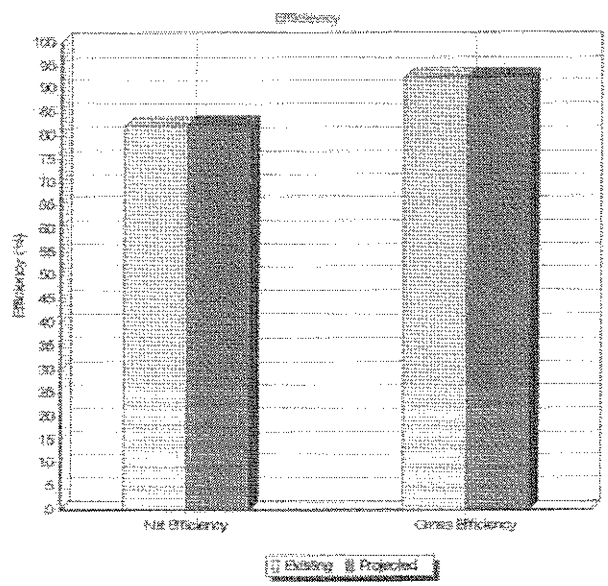
Company Name: Sunrise Soya Foods

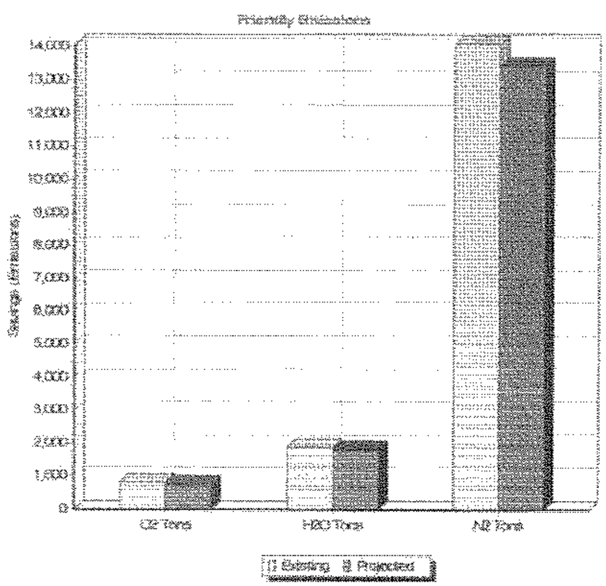
Site Name: Sunrise Soya Foods

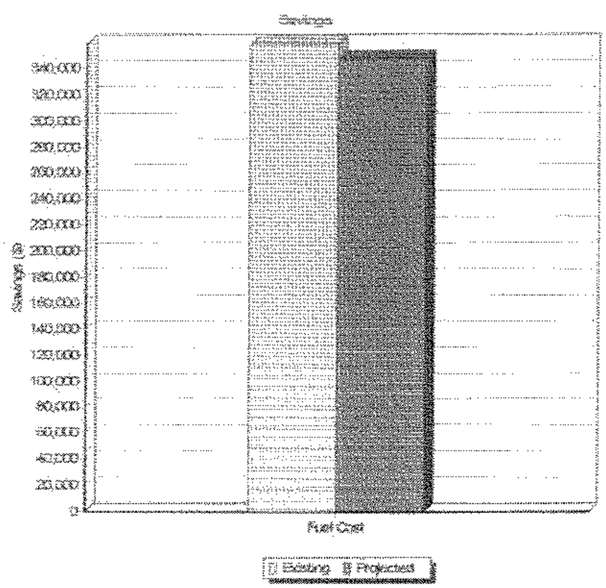
Engineers Name: Jackie Ng

Projected Savings Per year









PBL
COMBUSTION SPECIALISTS

PACIFIC BOILER LTD.

#105 19292 60[TH] Ave Surrey BC V3S 3M2 Phone 604-539-9551 Fax 604-539-9553 Toll free 1-866-722-2645
email jeff@pacific-boiler.com

AUTOFLAME
Combustion Management Systems

Sunrise Soya Foods
Att:Jackie Ng
Att: Ken Lee

Re: Combustion Calculator Savings Report

This report has been generated on the following information:

Note* All O2% and temperature figures, are averages based on combustion analysis readings from low to high fire, as taken on June 6, 2007.

Existing O2% (average from low to high)	= 4.1% O2
Projected O2% (average from low to high)	= 3.8% O2
Existing Stack Temperature (average from low to high)	= 478 deg. F
Projected Stack Temperature (average from low to high)	= 475.30 deg. F
Cost of Fuel	= $9.25/GJ
Average firing rate	= 50% (4200CF/H of CH4)

Overall Fuel Savings for the year have been based on the burner running at 50% (4200CF/H), 24 hours a day, 7 days a week, for the entire year. The main concentration should be on the projected savings percentage of 3.22%. Any payback schedule and savings projection numbers are directly related to your individual burner's characteristics, performance, run time, cost of fuel, and general condition of the overall boiler. Please note that these are projected numbers based on the information taken on June 6, 2007, and not a scientific guarantee. It is with great appreciation for your time and efforts in viewing our proposal for the Autoflame Combustion Management System, and we look foreword to optimizing your overall burner efficiency.

Regards,

Jeff Staiker
Industrial Instrumentation Technician
www.pacific-boiler.com