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FIELD TEST.

EVALUATION OF FTC COMBUSTION CATALYST AT BELLEVUE GOLD MINE POWER STATION

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Report prepared by:

R.A. Platt
Fuel Technology Pty Ltd
70 Adelaide Street
FREMANTLE WA 6160

Tel: (09) 335 6446
Fax: (09) 430 5403

ACN 005 945 915

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Summary

Bellevue Gold Mine has been using FTC combustion catalyst for a number of years, and the cleanliness of engine combustion spaces has been acknowledged. However, management has expressed concerns as to the economic viability of the product as it relates to fuel efficiency.

A decision was made in July to cease treatment, and Fuel Technology offered to measure combustion change, if any, after three months non fuel treatment, employing the Specific Fuel Consumption method and taking into account known variables, such as temperature and fuel density.

Concurrent with this study Fuel Technology also trialled its new technology catalyst developed and patented in Australia. Both products show a fuel efficiency benefit in the range 2.3% to 5.6% after corrections for variables.

TEST PROCEDURE

The test method employed, Specific Fuel Consumption (SFC) is an engineering test whereby the absolute amount of fuel consumed by the equipment at specified power settings is determined by volume or weight measurement. Volumes are corrected for temperature and density variations.

Carbon Balance measurement (CB) tests were also made on the FTC+ product. This method involves calculation of the mass of carbon in the exhaust, as a measure of the fuel being burned. The elements measured in this test include the exhaust gas composition, its temperature and the gas flow rate calculated from the pressure and exhaust stack cross sectional area. This is an engineering standard test (AS 2077-1982). Concurrent with this test procedure Bosch Smoke measurements are also conducted, as another method of verifying improved combustion.

Treated fuel tests were conducted on Units Nos 1, 4 & 5 on 5 July 1992, prior to treatment ceasing, and return to baseline tests on 4 October 1992. Also included in the baseline tests were new gensets Units Nos 2 & 3.

The tests were conducted on Sundays, when the mine power requirement is steady, eg no winding motor running on an intermittent basis. However, there are still some load variations due to compressor and other equipment starts.

Units Nos 2 & 3 were tested by baseline and treated measurements between the hours 5 pm to 11 pm when the load was most steady.

FTC+ was tested on 25 October 1992, Carbon Balance tests were conducted with our Horiba infra red analyser, smoke measurements by means of our Bosch instrumentation.

The SFC tests were conducted employing our Microvip MK 1.2 Energy Analyser connected to each generators section of the switchboard. Fuel flow was measured by the individual flow meters fitted to each engine. Elapsed time by a quartz crystal digital stop watch.

RESULTS

Carbon Balance Measurements

CB tests were conducted by Infra red analysis for untreated baseline and FTC+ treated fuel. Table I sets out the results. Table II sets out the results corrected for load variation between baseline and treated tests.

Note, Unit No 1 is a Cummins KTA38, all other units are Cummins KTA50. The engines are a vee form and exhaust discharges via individual trunking and exhaust stacks.

TABLE I

CB Test Results FTC+ - Carbon Flow (g/s)

Unit No	Load kW		Carbon Flow		Change
	Baseline	Treated	Baseline	Treated	%
1	360	380	16.157	16.896	+ 4.6
2	560	575	20.462	19.170	- 6.3
3	590	580	21.772	20.097	- 7.7
5	580	575	21.617	19.879	- 8.0
Average			20.002	19.011	- 4.9

TABLE II

CB Test Results FTC+ - Carbon Flow Corrected for Load (kg/kWh)

Unit No	Load kW		Carbon Flow		Change
	Baseline	Treated	Baseline	Treated	%
1	360	380	0.1616	0.1610	-1.0
2	560	570	0.1316	0.1215	-7.7
3	590	580	0.1334	0.1248	-6.4
5	580	575	0.1342	0.1244	-7.3
Average			0.1402	0.1329	-5.2

The Bosch Smoke measurements taken during FTC Treated, baseline and treated FTC+ tests are described in Table III.

TABLE III

Bosch Smoke Comparison

Unit No	Load kW	Bosch Reading		FTC+
		FTC Treated 5/7/92	Baseline 4/10/92	Treated 25/10/92
1L	360/380	1.0	1.1	0.7
1R	360/375	0.6	1.5	1.0
2L	560/560	N/A	0.9	1.4
2R	560/575	N/A	1.4	1.2
3L	595/580	N/A	1.0	1.0
3R	580/580	N/A	0.7	1.0
4L	580/NA	0.9	N/T	N/T
4R	580/NA	1.0	N/T	N/T
5L	580/580	0.6	0.8	0.7
5R	580/570	0.7	0.5	0.7
Average		0.8	0.99	0.96

The deterioration in smoke following withdrawal of FTC from the fuel is 23.75%. The average improvement following addition of FTC + is 3%, however, our general experience is that smoke variations are not measurable in time periods less than three months.

SPECIFIC FUEL CONSUMPTION MEASUREMENTS

SFC tests were conducted on Units Nos 1, 4 & 5 on 5 July 1992 running on FTC. Return to baseline tests were conducted on Units Nos 1, 4 & 5 on 4 October, and the new units Nos 2 & 3. FTC+ treated tests were conducted on Units Nos 2, 3, 4 & 5 on 25 October. Units Nos 4 & 5 having high hours, Units 2 & 3 low hours.

The Summary of the test results shown in Table IV are volumetric measurements. Table V shows the data corrected for fuel density and temperature.

TABLE IV

SFC Test Results L/kWh

Unit No	FTC Treated 5/7/92	Baseline 4/10/92	Change %	FTC+Treated 25/10/92	Change %
1	0.2788	0.2886	+ 3.5	N/T	
2	N/A	0.2859		0.2804	-1.9
3	N/A	0.2872		0.2814	-2.0
4	0.2657	0.2350*	-11.5	0.2402	+2.2
5	0.2764	0.2872	+ 3.9	0.2751	-4.2

* This very large variation in efficiency between tests and also when compared to sister engines suggests a fuel meter error.

TABLE V

SFC Test Results kg/kWh

Unit No	FTC Treated 5/7/92	Baseline 4/10/92	Change %	FTC+Treated 25/10/92	Change %
1	0.2320	0.2384	+2.8		
2	N/A	0.2361		0.2319	-1.8
3	N/A	0.2384		0.2321	-2.6
4	0.2120	0.1932	-8.9	0.1967	+1.8
5	0.2291	0.2366	+3.3	0.2261	-4.4

Reviewing the above data and excluding the results of Unit No 4 which appear anomalous, the return to baseline following cessation of FTC treatment shows a decline in efficiency in the range 2.8% to 3.3%. Following addition of FTC+ the new engines 2 & 3 show an improving efficiency averaging 2.2%. Engine 5 shows an efficiency gain of 4.4%.

Cummins performance data stipulates that for every 10°C change in aspirating air temperature, efficiency gains or loses 1%. Adjusting the results for the temperature variables measured are shown in Table VI.

TABLE VI

Corrections for Ambient Temperature Change

Unit No	FTC Treated 2/7/92 °C	Baseline 4/10/92 °C	Indicated Correction	FTC+Treated 5/10/92 °C	Indicated Correction
1	16.0	22.0	+0.6		
2	N/A	18.0		22.0	+0.4
3	N/A	18.0		24.0	+0.6
4	15.5	24.0	+0.85	34.0	+1.0
5	15.0	24.5	+0.95	36.5	+1.2

Table VII shows the corrected engine efficiency change as a result of applying the corrections in table VI to the values in table V.

TABLE VII

SFC Corrected Efficiency Gains

Unit No	FTC Treated 5/7/92	Baseline 4/10/92	Change %	FTC+Treated 25/10/92	Change %
1	*	*	+2.2	*	
2		*		*	-2.3
3		*		*	-3.2
4	*	*	-9.75	*	+0.8
5	*	*	+2.35	*	-5.6

CONCLUSIONS

Based on CB test results the FTC+ fuel treatment indicates an average 5.2% reduction in carbon flow compared to the baseline values.

The smoke test comparisons indicate a 23.7% benefit in favour of FTC and 3% for FTC+. However, the test duration with FTC+ of three weeks is low and two of the test engines are new which will impact on the results.

The SFC test results, excluding engine No 4 indicate a decreased efficiency following removal of FTC from the fuel, and an average 3.7% efficiency gain on introducing FTC+.

These results compare favourably with our experience in similar stations operating Cummins gensets. The tests were conducted in the most careful and thorough manner possible in a commercial situation. On balance the FTC+ product appears to be performing better than the original FTC material.

Appendix A

CARBON BALANCE
COMPUTER PRINTOUTS

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 1 R/Bank
ENG. TYPE : CUMMINS — MODEL : KTA38
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 33204 — ENG. RPM:
AMB. TEMP (C) : 32 — STACK(mm): 160
BAROMETRIC(mb): 963 — LOAD: 360 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	271	269	271	272	273	271	0.55
EXHST TEMP (C):	403.5	403.7	403.8	403.9	404.1	404	0.06
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	6.83	6.83	6.83	6.83	6.83	6.83	0.00
O2 (%) :	10.34	10.33	10.33	10.33	10.30	10.33	0.15
CARB FLOW(g/s):	7.628	7.599	7.627	7.640	7.653	7.629	0.26

REYNOLDS NR. : 5.56E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 33627 — ENG. RPM:
AMB. TEMP (C) : 45.4 — STACK(mm): 160
BAROMETRIC(mb): 958 — LOAD: 370-380 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	268	269	268	268	268	268	0.17
EXHST TEMP (C):	428.9	429.3	429.3	429.4	429.4	429	0.05
HC (ppm) :	0	0	0	0	0	0.0	#DIV/0!
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	7.12	7.10	7.09	7.09	7.09	7.10	0.18
O2 (%) :	10.05	10.05	10.05	10.05	10.05	10.05	0.00
CARB FLOW(g/s):	7.735	7.726	7.701	7.700	7.700	7.712	0.22

REYNOLDS NR. : 5.42E+04 — TOTAL HOURS ON TREATED FUEL : 423

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : 1.1 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 1 L/Bank
ENG. TYPE : CUMMINS — MODEL : KTA38
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 33204 — ENG. RPM:
AMB. TEMP (C) : 32 — STACK(mm): 160
BAROMETRIC(mb): 963 — LOAD: 360 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	346	348	347	345	346	346	0.33
EXHST TEMP (C):	392.3	392.5	392.6	392.8	393	393	0.07
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	6.71	6.71	6.69	6.69	6.69	6.70	0.16
O2 (%) :	10.41	10.41	10.40	10.40	10.40	10.40	0.05
CARB FLOW(g/s):	8.540	8.563	8.525	8.499	8.511	8.528	0.29

REYNOLDS NR. : 6.34E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 33627 — ENG. RPM:
AMB. TEMP (C) : 45.4 — STACK(mm): 160
BAROMETRIC(mb): 958 — LOAD: 370-380 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	372	373	374	372	372	373	0.24
EXHST TEMP (C):	427.4	427.8	428.1	428.4	428.5	428	0.11
HC (ppm) :	0	0	0	0	0	0.0	#DIV/0!
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	7.16	7.16	7.17	7.17	7.17	7.17	0.08
O2 (%) :	10.09	10.09	10.09	10.09	10.09	10.09	0.00
CARB FLOW(g/s):	9.174	9.183	9.206	9.180	9.179	9.184	0.14

REYNOLDS NR. : 6.39E+04 — TOTAL HOURS ON TREATED FUEL : 423

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : 7.7 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 2 R/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 772 — ENG. RPM:
AMB. TEMP (C) : 28.4 — STACK(mm): 200
BAROMETRIC(mb): 965 — LOAD: 560 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	196	198	195	195	198	196	0.77
EXHST TEMP (C):	451.1	451.3	451.4	451.6	451.7	451	0.05
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	7.43	7.43	7.43	7.42	7.42	7.43	0.07
O2 (%) :	9.51	9.50	9.50	9.50	9.49	9.50	0.07
CARB FLOW(g/s):	10.666	10.719	10.637	10.621	10.702	10.669	0.39

REYNOLDS NR. : 4.58E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 1273 — ENG. RPM:
AMB. TEMP (C) : 38 — STACK(mm): 200
BAROMETRIC(mb): 959 — LOAD: 570-580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	170	171	172	171	169	171	0.67
EXHST TEMP (C):	467.5	467.5	467.5	467.5	467.5	468	0.00
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.04	0.04	0.04	0.04	0.04	0.040	0.00
CO2 (%) :	7.77	7.77	7.76	7.76	7.76	7.76	0.07
O2 (%) :	11.00	10.98	10.98	10.96	10.96	10.98	0.15
CARB FLOW(g/s):	10.239	10.269	10.286	10.256	10.196	10.249	0.34

REYNOLDS NR. : 4.21E+04 — TOTAL HOURS ON TREATED FUEL : 501

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -3.9 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 2 L/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 772.4 — ENG. RPM:
AMB. TEMP (C) : 28.5 — STACK(mm): 200
BAROMETRIC(mb): 965 — LOAD: 560 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	166	165	168	166	168	167	0.81
EXHST TEMP (C):	464.5	464.5	464.6	464.6	464.6	465	0.01
HC (ppm) :	20	20	20	20	20	20.0	0.00
CO (%) :	0.04	0.04	0.04	0.04	0.04	0.040	0.00
CO2 (%) :	7.44	7.42	7.45	7.46	7.48	7.45	0.30
O2 (%) :	9.21	9.21	9.20	9.20	9.20	9.20	0.06
CARB FLOW(g/s):	9.763	9.707	9.834	9.788	9.873	9.793	0.65

REYNOLDS NR. : 4.18E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 1273 — ENG. RPM:
AMB. TEMP (C) : 38 — STACK(mm): 200
BAROMETRIC(mb): 959 — LOAD: 560 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	142	144	142	143	144	143	0.70
EXHST TEMP (C):	471.8	471.9	471.9	471.9	472	472	0.01
HC (ppm) :	0	0	0	0	0	0.0	#DIV/0!
CO (%) :	0.05	0.05	0.05	0.05	0.05	0.050	0.00
CO2 (%) :	7.39	7.39	7.40	7.40	7.39	7.39	0.07
O2 (%) :	10.00	10.98	10.98	10.96	10.96	10.78	4.03
CARB FLOW(g/s):	8.891	8.946	8.896	8.927	8.946	8.921	0.30

REYNOLDS NR. : 3.84E+04 — TOTAL HOURS ON TREATED FUEL : 500.6

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -8.9 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 3 R/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 822 — ENG. RPM:
AMB. TEMP (C) : 29.6 — STACK(mm): 200
BAROMETRIC(mb): 965 — LOAD: 580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	190	190	192	192	192	191	0.57
EXHST TEMP (C):	445.6	446	446.3	446.6	446.9	446	0.11
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.02	0.02	0.02	0.02	0.02	0.020	0.00
CO2 (%) :	7.44	7.40	7.40	7.40	7.42	7.41	0.24
O2 (%) :	9.65	9.66	9.63	9.60	9.60	9.63	0.29
CARB FLOW(g/s):	10.541	10.481	10.535	10.533	10.559	10.530	0.27

REYNOLDS NR. : 4.54E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 1326 — ENG. RPM:
AMB. TEMP (C) : 44.4 — STACK(mm): 200
BAROMETRIC(mb): 958 — LOAD: 580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	170	171	168	169	168	169	0.77
EXHST TEMP (C):	468.5	468.5	468.5	468.5	468.5	469	0.00
HC (ppm) :	0	0	0	0	0	0.0	#DIV/0!
CO (%) :	0.04	0.04	0.04	0.04	0.04	0.040	0.00
CO2 (%) :	7.68	7.69	7.68	7.69	7.69	7.69	0.07
O2 (%) :	9.72	9.72	9.72	9.72	9.72	9.72	0.00
CARB FLOW(g/s):	10.111	10.153	10.051	10.094	10.064	10.094	0.40

REYNOLDS NR. : 4.19E+04 — TOTAL HOURS ON TREATED FUEL : 504

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -4.1 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 3 L/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 822 — ENG. RPM:
AMB. TEMP (C) : 27.2 — STACK(mm): 200
BAROMETRIC(mb): 965 — LOAD: 590-600 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	198	197	198	196	198	197	0.45
EXHST TEMP (C):	465.1	465.6	465.8	466	466.3	466	0.10
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	7.88	7.87	7.89	7.90	7.88	7.88	0.14
O2 (%) :	9.07	9.09	9.07	9.07	9.07	9.07	0.10
CARB FLOW(g/s):	11.258	11.212	11.267	11.222	11.249	11.242	0.21

REYNOLDS NR. : 4.55E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 1326 — ENG. RPM:
AMB. TEMP (C) : 44.3 — STACK(mm): 200
BAROMETRIC(mb): 958 — LOAD: 580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	163	163	164	163	163	163	0.27
EXHST TEMP (C):	471.9	472.1	472.3	472.3	472.3	472	0.04
HC (ppm) :	0	0	0	0	0	0.0	#DIV/0!
CO (%) :	0.04	0.04	0.04	0.04	0.04	0.040	0.00
CO2 (%) :	7.77	7.77	7.78	7.78	7.78	7.78	0.07
O2 (%) :	9.89	9.89	9.89	9.89	9.89	9.89	0.00
CARB FLOW(g/s):	9.991	9.990	10.032	10.001	10.001	10.003	0.17

REYNOLDS NR. : 4.10E+04 — TOTAL HOURS ON TREATED FUEL : 504

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -11.0 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 5 R/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 34746.5 — ENG. RPM:
AMB. TEMP (C) : 27.2 — STACK(mm): 200
BAROMETRIC(mb): 966 — LOAD: 560-600 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	199	197	200	199	197	198	0.68
EXHST TEMP (C):	416.4	416.5	416.5	416.6	416.7	417	0.03
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.02	0.02	0.02	0.02	0.02	0.020	0.00
CO2 (%) :	7.44	7.40	7.40	7.40	7.40	7.41	0.24
O2 (%) :	9.63	9.63	9.61	9.61	9.60	9.62	0.14
CARB FLOW(g/s):	11.019	10.905	10.987	10.959	10.903	10.955	0.47

REYNOLDS NR. : 4.72E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 35215 — ENG. RPM:
AMB. TEMP (C) : 38.6 — STACK(mm): 200
BAROMETRIC(mb): 957 — LOAD: 560-580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	181	183	180	180	181	181	0.68
EXHST TEMP (C):	418.9	419.4	420	420	420.1	420	0.12
HC (ppm) :	20	20	20	20	20	20.0	0.00
CO (%) :	0.03	0.03	0.03	0.03	0.03	0.030	0.00
CO2 (%) :	7.19	7.15	7.15	7.15	7.15	7.16	0.25
O2 (%) :	10.45	10.45	10.45	10.45	10.45	10.45	0.00
CARB FLOW(g/s):	10.110	10.106	10.019	10.019	10.046	10.060	0.45

REYNOLDS NR. : 4.48E+04 — TOTAL HOURS ON TREATED FUEL : 468.5

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -8.2 %

REMARKS:

FUEL TECHNOLOGY PTY LTD — CARBON BALANCE RESULTS

COMPANY : BELLEVUE GOLD MINE — LOCATION : LEINSTER

EQUIPMENT : GENSET — UNIT NR. : 5 L/Bank
ENG. TYPE : CUMMINS — MODEL : KTA50
RATING : — FUEL : ADO

BASELINE — DATE : 4.10.92

ENG. HOURS : 34746.5 — ENG. RPM:
AMB. TEMP (C) : 27.2 — STACK(mm): 200
BAROMETRIC(mb): 966 — LOAD: 570-590 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	191	192	190	191	190	191	0.44
EXHST TEMP (C):	421.3	421.5	421.7	421.8	421.8	422	0.05
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.02	0.02	0.02	0.02	0.02	0.020	0.00
CO2 (%) :	7.38	7.37	7.37	7.38	7.38	7.38	0.07
O2 (%) :	9.00	8.99	8.98	8.97	8.96	8.98	0.18
CARB FLOW(g/s):	10.676	10.688	10.631	10.672	10.645	10.662	0.22

REYNOLDS NR. : 4.61E+04

TREATED TEST — DATE : 25.10.92

ENG. HOURS : 35215 — ENG. RPM:
AMB. TEMP (C) : 38.6 — STACK(mm): 200
BAROMETRIC(mb): 957 — LOAD: 580 KW

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	AVERAGE	% ST.DEV
PRES DIFF (Pa):	179	180	179	178	179	179	0.40
EXHST TEMP (C):	423.1	423.2	423.2	423.4	423.5	423	0.04
HC (ppm) :	10	10	10	10	10	10.0	0.00
CO (%) :	0.04	0.04	0.04	0.04	0.04	0.040	0.00
CO2 (%) :	7.02	7.02	7.05	7.04	7.06	7.04	0.25
O2 (%) :	10.34	10.34	10.34	10.34	10.34	10.34	0.00
CARB FLOW(g/s):	9.796	9.823	9.837	9.794	9.848	9.819	0.25

REYNOLDS NR. : 4.44E+04 — TOTAL HOURS ON TREATED FUEL : 468.5

PERCENTAGE CHANGE IN FUEL CONSUMPTION ((TREATED-BASE)/BASE*100) : -7.9 %

REMARKS:

Appendix B

SPECIFIC FUEL CONSUMPTION DATA SHEETS

FUEL TECHNOLOGY PTY. LTD.

FOR: Pellaring Gold Mine

ENGINE NO. 1

Date: Base 5-7-

DIESEL GENERATING UNIT DATA TEST SHEET

Location _____

Treated _____

0.832 / 27.2

ENGINE:

Make Cummins

Model 4TA 38

Serial No _____

Eng Hrs Start 32223.13 Finish _____

ALTERNATOR:

Make _____

Model _____

Serial No _____

Rating _____

Density @ 15°: Base _____

Treated _____

Flash Point PM
Closed Cup _____

TIME Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
12.30		440	113 236			431	635	0357527.2						
12 45	15	392	213 998	100.762	403	432	562	0357555.3	28.1	0.278		16/11.5		
1.00	15	409	309 114	95.116	380	432	598	0357582.2	26.9	0.282		16/11.5		
1.15	15	415	408 458	99 37	397	433	597	0357610.2	28	0.281		16.5/11.5		
1 30	15	425	522 887	114 403	457	433	612	03576414	31.2	0.272		16.5/11.5		
			Ave	409.651					114 2	0.2788				

FUEL TECHNOLOGY PTY. LTD. FOR: BELLEVUE GOLD MINE ENGINE NO. 1 Date: Base 4-10-92

DIESEL GENERATING UNIT DATA TEST SHEET Location _____ Treated _____

0.826 @ 34.4

ENGINE: ALTERNATOR:

Make Cummins Make _____ Density @ 15°: Base _____

Model KTA 38 Model _____ Treated _____

Serial No _____ Serial No _____ Flash Point PM Closed Cup _____

Eng Hrs Start 33208 Finish _____ Rating _____

TIME PM Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
5.38		393	2391.006			432	582	0458389.3				22/13.5		
5.53	15	391	2487.714	96.708		432	578	0458417.3	28.0	0.2895		22/13.5		
6.08	15	411	2587.547	99.833		431	611	0458446.1	28.8	0.2885		22/13.5		
6.23	15	407	2688.431	100.884		431	594	0458475.2	29.1	0.2884		22/13.5		
6.38	15	407	2789.041	100.61		431	598	0458504.2	29.0	0.2882		21.5/13.5		
				398.035					114.9	0.2886				

FUEL TECHNOLOGY PTY. LTD. FOR: BELLEVUE GOLD MINE ENGINE NO. 2 Date: Base 4-10-92

DIESEL GENERATING UNIT DATA TEST SHEET Location _____ Treated _____

ENGINE: ALTERNATOR: 0.826/32.8

Make Cummins Make _____ Density @ 15°: Base _____

Model KTA 50 Model _____ Treated _____

Serial No _____ Serial No _____ Flash Point PM

Closed Cup _____

Eng Hrs Start 778 Finish _____ Rating _____

TIME PM Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
8.21		516	3544.539			437	706	1197890.0				18/13		
8.36	15	517	3672.714	128.175	512.7	437	711	11979266	36.6	0.2855		18/13		
8.51	15	510	3800.599	127.885	511.4	437	704	1197963.1	36.5	0.2854		18/13		
9.06	15	505	3927.219	126.62	506.5	437	696	1197999.3	36.2	0.2858		18/13		
9.21	15	497	4053.307	126.088	504.4	437	689	1198035.5	36.2	0.2871		18/13		
				508.768					145.5	0.2859				
				SUGGEST RUN TREATED TRIALS ON NEW ENGINES AT SAME TIME										
					LOAD VERY STEADY.									

FUEL TECHNOLOGY PTY. LTD. FOR: SELCEVUE GOLD MINE ENGINE NO. 2 Date: Base

DIESEL GENERATING UNIT DATA TEST SHEET Location Treated 25-10-92

ENGINE: ALTERNATOR: 0.827 @ 39.6

Make Cummins Make Density @ 15°: Base

Model KTA 50 Model Treated

Serial No Serial No Flash Point PM

Closed Cup

Eng Hrs Start Finish 1273 Rating 800 kw

TIME pm Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
8.20		512	2945.781			434	719	1271532.4				28/15.5		
8.35	15	519	3074.483	128.702	514.8	435	720	1271568.4	36	0.2797		28/15.5		
8.50	15	508	3204.018	129.535	518.1	435	713	1271604.7	36.3	0.2802		28/15.5		
9.05	15	518	3332.622	128.604	514.4	435	729	1271640.9	36.2	0.2814		28/15.5		
9.20	15	521	3459.688	127.066	508.3	434	724	1271676.5	35.6	0.2802		28/15.5		
				513.907					144.1	0.2804				

FUEL TECHNOLOGY PTY. LTD. FOR: BELLEVUE GOLD MINE ENGINE NO. 3 Date: Base 4-10-92

DIESEL GENERATING UNIT DATA TEST SHEET Location _____ Treated _____

0.830 / 29.2

ENGINE: ALTERNATOR: Density @ 15°: Base _____

Make Cummins Make _____

Model KTA 50 Model _____ Treated _____

Serial No _____ Serial No _____ Flash Point PM Closed Cup _____

Eng Hrs Start 822 Finish _____ Rating _____

TIME PM Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
9.41		506	4211.611			437	685	1129363.8				18.5 / 13		
9 56	15	515	4339.100	127.489	509.9	437	707	1129400.6	36.8	0.2886		18.5 / 13		
10.11	15	517	4467.061	127.961	511.8	437	703	1129437.3	36.7	0.2868		18 / 13		
10 26	15	517	4595.027	127.966	511.8	437	696	1129474.1	36 8	0.2875		18 / 13		
10.41	15	504	4722.699	127.672	510.7	437	699	1129510.6	36.5	0.2858		18 / 13		
				511.088					146.8	0.2872				

FUEL TECHNOLOGY PTY. LTD. FOR: BELLEVUE GOLD MINE ENGINE NO. 3 Date: Base _____

DIESEL GENERATING UNIT DATA TEST SHEET Location _____ Treated 25-10-92

ENGINE: ALTERNATOR: 0.828 @ 36.6

Make CUMMINS Make _____ Density @ 15°: Base _____

Model KTA 50 Model _____ Treated _____

Serial No _____ Serial No _____ Flash Point PM

Closed Cup _____

Eng Hrs Start _____ Finish 1326 Rating 800 kw

TIME PM Start / Finish	Δ T	Nom. Load Kw	KWh Start / Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start / Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry / Wet	J.W. Out / In	LO
9.50		514	194.817			435	708	1206507.1						
10.05	15	504	321.922	127.105	508.4	435	699	1206542.7	35.6	0.2801		24.5 / 15.5		
10.20	15	501	448.945	127.023	508.1	435	684	1206578.2	35.5	0.2795		24 / 15.5		
10.35	15	502	575.296	126.351	505.4	435	688	1206614.0	35.8	0.2833		24 / 15.5		
10.50	15	501	701.340	126.044	504.2	435	694	1206649.6	35.6	0.2824		23 / 15		
				506.523					142.5	0 2814				

FUEL TECHNOLOGY PTY. LTD.

FOR: Ballarat Gold Mine

ENGINE NO. 4

Date: Base 5-7-92

Location _____

Treated _____

0.828 / 37.2

DIESEL GENERATING UNIT DATA TEST SHEET

ENGINE:
Make Cummins

Model KTA 50

Serial No _____

Eng Hrs Start 39109.88 Finish _____

ALTERNATOR:
Make _____

Model _____

Serial No _____

Rating _____

Density @ 15°: Base _____

Treated _____

Flash Point PM
Closed Cup _____

TIME Start Finish	Δ T	Microvip Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
11.15		586	153.347			434	909	0918213.6						
11.30	15	584	298.876	145529	582	434	902	0918252.1	38.5	0.264		15.5 / 11.5		
11 45	15	575	443.021	144.145	576	434	909	0918290.5	38.4	0.266		15.5 / 11.5		
12.00	15	568	588.302	145.281	581	434	880	0918329.1	38.6	0.265		15.5 / 11.5		
12.15	15	568	732.264	143.962	576	434	880	0918367.4	38.3	0.266		15.5 / 11.5		
			Ave	578.917					153.8	0.265				

FUEL TECHNOLOGY PTY. LTD. FOR: BILLIEVILLE GOLD MINE ENGINE NO. 4 Date: Base 4-10-92

DIESEL GENERATING UNIT DATA TEST SHEET Location _____ Treated _____

ENGINE: ALTERNATOR: 0.822 / 40.5

Make CUMMINS Make _____ Density @ 15°: Base _____

Model KTA 50 Model _____ Treated _____

Serial No _____ Serial No _____ Flash Point PM Closed Cup _____

Eng Hrs Start _____ Finish _____ Rating _____

TIME PM Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
3.51		596	1481.841			442	978	1220666.7				24/14		
4.06	15'	603	1630.945	149.104	596.4	442	952	1220701.4	34.7	0.2327		24/14		
4.21	15'	582	1778.255	147.31	589.2	442	928	1220735.9	34.5	0.2341		24/14		
4.36	15'	575	1918.771	140.516	562.1	442	925	1220769.2	33.3	0.2369		24/14		
4.51	15'	569	2061.303	142.532	570.1	442	916	1220802.9	33.7	0.2364		24/14		
				579.462					136.2	0.2350				

FUEL TECHNOLOGY PTY. LTD.

FOR: Telfer Gold Mine

ENGINE NO. 5

Date: Base 5-7-9

Location _____

Treated _____

DIESEL GENERATING UNIT DATA TEST SHEET

ENGINE:
Make Cummins
Model KTA 50
Serial No _____
Eng Hrs Start 0370538 Finish _____

ALTERNATOR:
Make _____
Model _____
Serial No _____
Rating _____

0.831 / 30.5°
Density @ 15°: Base _____
Treated _____

Flash Point PM
Closed Cup _____

TIME Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
9.55		586	266.146			431	912	0857316.2				15/11		
9.10	15	582	409.110	144.966	579	431	901	0857356.0	39.8	0.274		15/11		
10.05	15	582	552.922	143.812	575	431	858	0857395.6	39.6	0.275		15/11		
10.20	15	537	690.214	137.292	549	432	846	0857433.8	38.2	0.278		15/11.5		
10.35	15	586	832.863	142.649	570	432	955	0857473.4	39.6	0.277		15/11.5		
				568.719					157.2	0.276				

FUEL TECHNOLOGY PTY. LTD. FOR: [illegible] GOLD MINE ENGINE NO. 4 Date: Base

DIESEL GENERATING UNIT DATA TEST SHEET Location Treated 25-10-92

ENGINE: ALTERNATOR: 0.819 @ 49.4

Make Cummins Make Density @ 15°: Base

Model [illegible] Model Treated

Serial No Serial No Flash Point PM

Closed Cup

Eng Hrs Start 41546 Finish 41546 Rating 800 kW

TIME Start Finish	Δ T	Nom. Load Kw	KWh Start Finish x10	Δ KwH	Kw. Av.	Kv Volts	Amps	FUEL Start Finish	Fuel ltrs.	Kwhr/kg L/kwh	TEMPERATURES °C E.Gas	Air In Dry Wet	J.W. Out In	LO
5.10		588	1557.178			439	933	1287413.9				34 / 16.5		
5.25	15	585	1704.126	146.948	587.8	440	927	1287449.3	35.4	0.2409		34 / 16.5		
5.40	15	590	1852.222	148.096	592.3	439	931	1287485.0	35.7	0.2410		32.5 / 15.5		
5.55	15	589	2000.615	148.393	593.5	439	938	1287520.6	35.6	0.2399		32.5 / 15.5		
6.10	15	589	2147.480	146.865	587.5	439	934	1287555.7	35.1	0.2389		32.5 / 15.5		
				590.302					141.8	0.2402				