CENTRAL ELECTRICITY BOARD
MAURITIUS
FUEL EFFICIENCY STUDY
UNIT NO 6, ST LOUIS
POWER STATION

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EXECUTIVE SUMMARY

Following meetings with the Central Electricity Board's General Manager and Production Manager during October, 1996 at the time of an Australian Trade Mission to Mauritius, Fuel Technology was asked to submit an Evaluation Proposal to trial the FPC-2 catalyst at St Louis Power Station.

The proposal was submitted during November, 1996 to evaluate FPC-2 in Unit No 6, a Pielstick 18 PC3 diesel alternator set. The evaluation was initiated during the week commencing 4th August, 1997 when baseline (*untreated fuel*) tests were run at four loads namely 6, 7, 8 and 8.5 MW.

An air-operated catalyst metering system, supplied on loan by Fuel Technology Pty Ltd, was set up and catalyst injection into the fuel commenced on Thursday 7th August,

Treated fuel tests commenced during week commencing 13th October, 1997 with the engine operating **as close as practicable** to the nominal baseline loads.

Electrical data was measured with a Microvip energy analyser and a hard copy of the data printed out every ten minutes. Fuel consumption was measured by a pair of MacNaught M40 flow meters complete with thermocouple probes. Data extraction of fuel flows was assessed by a Minitrol rate meter and temperatures by a Fluke digital thermometer. Central Electricity Board staff compiled and recorded the fuel flow and temperature measurements on log sheets which are included in the Appendix to this report.

The average increase in fuel efficiency is **5.45%,** after applying density corrections and correction for variation in the fuel oils calorific value. We calculate the net economic benefit provided by use of FPC-2 at St Louis Power Station to be **MR11,379,000 per annum**. The net benefit will increase to **MR21,917,000 annually** should a similar return be measured also at Fort Victoria Power Station.

TEST METHOD

The Specific Fuel Consumption (SFC) test procedure employed in this efficiency study measures the absolute amount of fuel consumed against work done by the engine over time at a constant load. From this data the engine's efficiency can be calculated.

This evaluation of FPC involves a series of back to back untreated (*baseline*) and treated fuel tests conducted approximately two months apart.

MEASUREMENT OF FUEL CONSUMED

A pair of calibrated MacNaught M-40 flow transducers were used to measure fuel supplied to the engine and also fuel returning from the engine from which the net volume of fuel consumed over a given time span, at ten minute intervals, can be assessed.

The flow transducers are fitted with thermocouple probes, which enable measurement of fuel temperature at each transducer. From the fuel temperature the density at that temperature is calculated. A sample of fuel oil was taken for laboratory analysis and the density determined at 15°C and 95°C. Copies of the Laboratory Reports are included in the Appendix.

Volumetric fuel flows are corrected for density and temperature and reported in mass (kg) of fuel.

MEASUREMENT OF WORK DONE

A Microvip MKII energy analyser was used to measure the alternator's electrical output parameters namely:-

KWatt	kVArh
Ampere	kWh
Volt	Hours
Hz	LmA
PF Med	MVAr

TEST PROCEDURE

Once the meters were installed into the fuel lines and the Microvip energy analyser connected to the control panel, a pair of stop watches were synchronised and data extracted at ten (10) minute intervals and recorded, as shown in the data sheets in the Appendix to this Report.

Recordings of fuel readings were in the main made by St Louis power station staff. The Microvip readings were recorded on a paper printout which also is included in the Appendix to the report.

TEST RESULTS

We have calculated the net calorific value of the baseline and treated fuel oils as follows:-

Density 0.951 @ 15°C	Calorific Value	9,920	Cal/g
Density 0.975 @15°C	Calorific Value	9,840	Cal/g

The lower density treated fuel has an 0.813% higher calorific value which, when applied to the efficiency gain calculated, namely 5.7% and 5.5%, will reduce these gains to **5.65%** and **5.45%** respectively.

A summary of the Mean Results achieved in this test program are shown in Table 1 below.

TABLE NO. 1

	Mean Results									
Nominal Load (kw)	6000		7000		8000		8500		Overall Average	
	Load	kg/kWh	Load	kg/kWh	Load	kg/kWh	Load	kg/kWh	Load	kg/kWh
Untreated	5971	0.2313	7290	0.2185	7785	0.2270	8522	0.2176	7392	0.2236
Treated	5963	0.2148	7474	0.2080	8271	0.2110	8681	0.2099	7597	0.2109
% Change	**-0.1%**	**-7.1%**	**2.5%**	**-4.8%**	**6.2%**	**-7.1%**	**1.9%**	**-3.6%**	**2.8%**	**-5.7%**

Computer printouts for each set of untreated and treated fuel tests conducted at the four nominal load settings 6, 7, 8 and 8.5 MW follow in the Appendix.

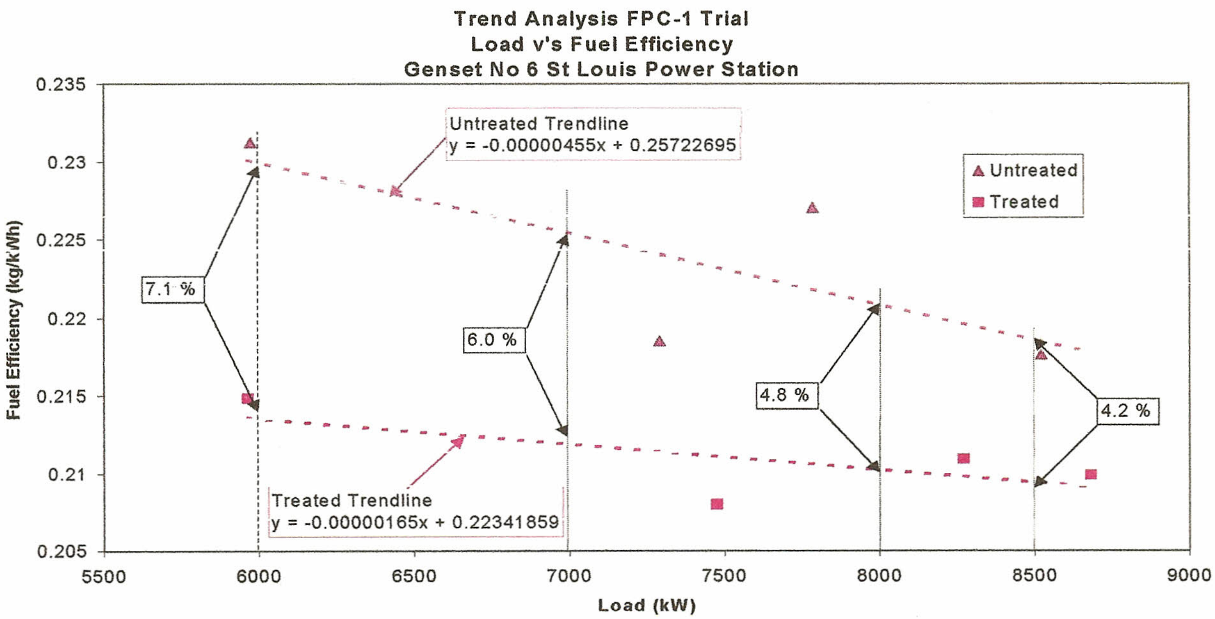
A Linear Trend Analysis has also been made as shown in Table 2 below.

TABLE NO. 2

Nominal Load(kW)	6000	7000	8000	8500	Overall Average
Fuel Efficiency (kg/kWh)					
Untreated	0.2299	0.2254	0.2208	0.2186	0.2237
Treated	0.2135	0.2119	0.2102	0.2094	0.2113
% Change	**-7.1%**	**-6.0%**	**-4.8%**	**-4.2%**	**-5.5%**

From this Linear Trend Analysis a graphical representation has been made which shows the level of efficiency gain at each load setting. Refer Graph 1 below:-

GRAPH NO 1

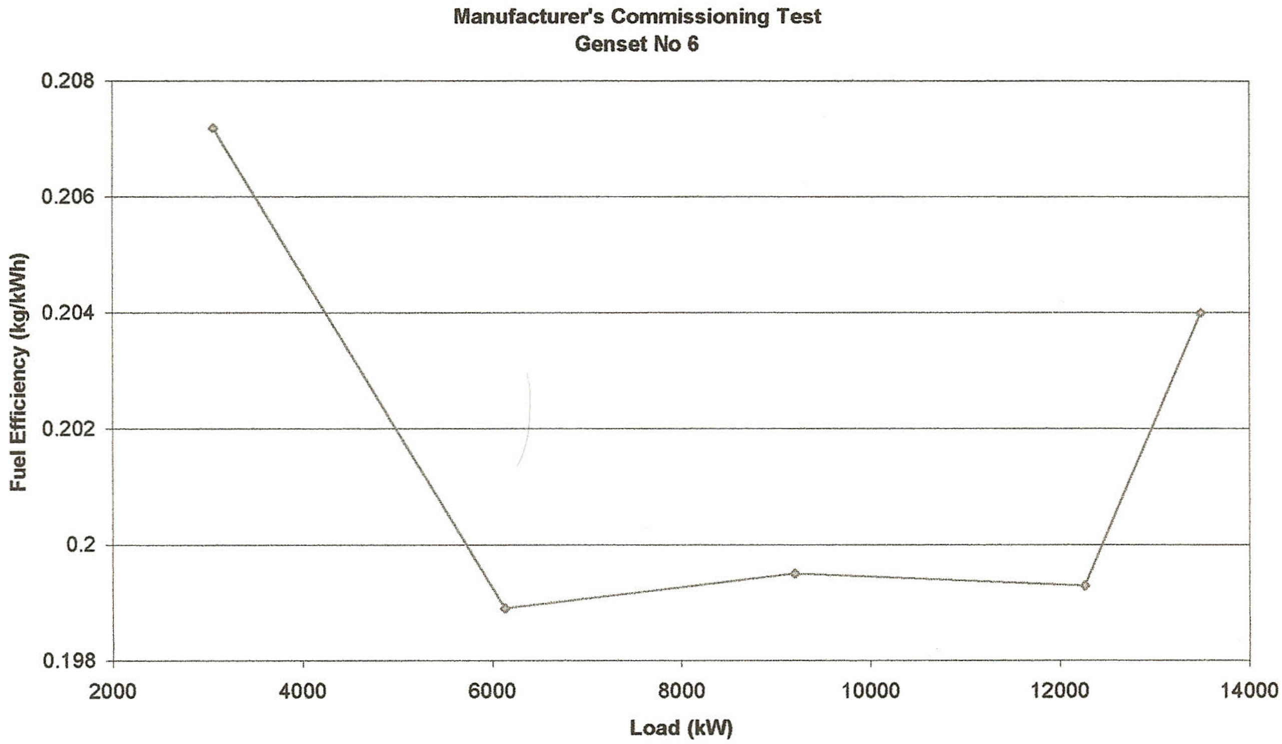


When this engine was commissioned by Pielstick a commissioning test was performed which provided the following efficiency results:-

Load	3065 kW	6130 kW	9195 kW	12260 kW	13486 kW
kg.kWh	0.2072	0.1989	0.1995	0.1993	0.2040

Graph No. 2 represents this data graphically.

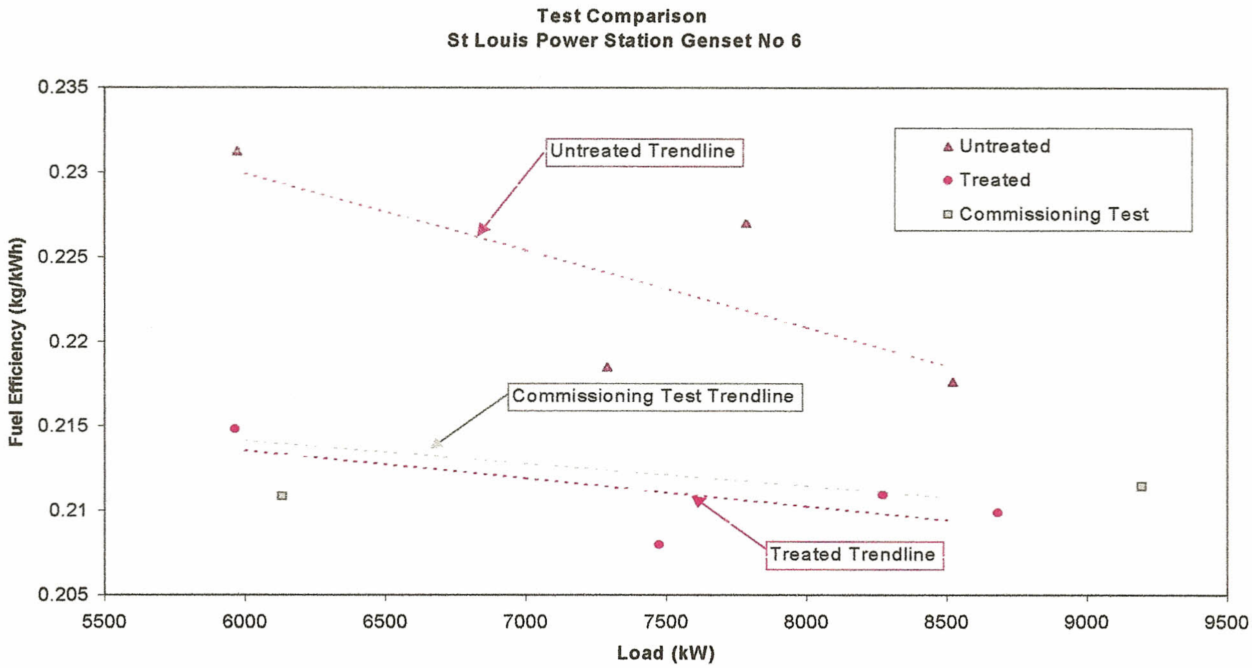
GRAPH NO. 2



Information provided by engineering staff at St. Louis Power Station detailing the manufacturer's commissioning test results has been used to make a comparison of the efficiency profile for untreated and FPC treated tests. Applying a 6% reduction in efficiency for alternator and parasitic loads to the commissioning test results it can be seen from Graph No. 3 that all tests reflect similar characteristics. In addition, the FPC treated fuel has provided an efficiency improvement approximating the level of No. 6 engine at time of commissioning.

Graph No. 3 below compares the current test results with the commissioning results over the range of load levels measured during the FPC evaluation tests.

GRAPH NO. 3



Photographs of the test equipment and FPC-2 metering system installed at St Louis Power Station during the test program follow after Page 6.

CONCLUSION

This carefully controlled engineering standard Specific Fuel Consumption (SFC) efficiency study on Unit No. 6 at St. Louis Power Station provides clear evidence of reduced fuel consumption and significant economic benefit to the Central Electricity Board by use of FPC-2.

The gross fuel efficiency gain has been calculated as 5.65% based on the overall average of the four loads tested or 5.45% based on the overall average of the Linear Trend Analysis after correcting for variance in the fuel's Calorific Value.

Data provided to Fuel Technology Pty Ltd covering the initial commissioning trials shows that following addition of FPC-2 to the engine's fuel supply that even after twenty years of service the engine is operating at very close to the efficiency level measured when the engine was new. Subjective comment from power station staff provides evidence of a cleaner engine following FPC-2 addition to the fuel.

FPC-2 will provide a more complete burn of the fuel which will result in cleaner engines, reduced wear and over time reduced maintenance expenditure.

ACKNOWLEDGEMENTS

Fuel Technology Pty Ltd thank Station Superintendent Mr Ajay Bucktowar and Assistant Station Superintendent Mr Shiam Krisht Thannoo for their courtesy, interest and assistance without which this evaluation would not have been achieved.