APPLICATION AND DEVELOPMENT OF ELECTRONIC MONITORING SYSTEMS IN NEW ZEALAND

Rory Bell

BELL TRANSPORT DEVELOPMENTS

NZ

Presented to the

Institute of Road Transport Engineers of New Zealand

FOURTH INTERNATIONAL HEAVY VEHICLE SEMINAR

AUCKLAND

3 - 5 March 1992

APPLICATION AND DEVELOPMENT OF ELECTRONIC VEHICLE MONITORING SYSTEMS IN N.Z.

INTRODUCTION :

Electronic Vehicle monitoring systems allow users to put fleet operations under a microscope . Providing information to identify wastage and proficiency in vehicle ,road transport and fleet operations . It is the most beneficial management tool available to fleet operators .

Combined with sound consulting advice and operational training it will change the way you do business , identifying ,enabling and monitoring reductions in operating costs , enhancing profits . They are an essential part of a quality management program.

Bell Transport Development now have over 80 vehicle monitoring units installed in a variety of vehicles at 17 locations from Auckland to Invercargil .

Clients include Line haul , Bulk , Livestock and General transport operators ,a Polytech , aluminium smelter ,oil companies, local government and two owner drivers .

Our policy is to offer systems that suit clients needs as opposed to product brand promotion . As a result we have established and support Ultralog, Silent Witness and Fleetcom systems in New Zealand and this month we are releasing the Triptrac range of vehicle computers for light to medium weight trucks , coaches , buses and later this year a model for cars .

As others are speaking on the subject of vehicle computers I will confine this paper to the application and development of these systems in N.Z and by New Zealanders .

Over the last six years i have been privileged to considerable data collected from vehicle monitoring systems in a number off applications .

I would like to pass on to you the key information and conclusions that i have reached in the hope that a recognition of the of potential for cost reductions in driver and operations management will stimulate increased action in this area , bring benefits to operators and our country .

Information and analysis :

Hutt Valley Polytechnic have a Silent Witness vehicle monitor fitted to there driver training vehicle a Mercedes Benz 1418 Tractor ,coupled to a two axle semi trailer .

The Silent Witness system developed for accident analysis , therefore provides detailed data , in a easy to understand format .

The data was obtained in controlled circumstances and involves experienced drivers . The test course is 13 km and includes motorway , city street and hill driving , traffic flows are variable with time of day the tests were done (time the test finished is marked on the right side of chart).

Note : Unfortunately the rpm information on Grant Childs test run was destroyed ,I have substituted the best recorded in the rpm ranges . His performance was noted as being better than any of the others in the after test analysis therefor the optimum achievable is likely to be greater than that noted .

The focus is on the variance of performance of drivers in the key areas of :

1. Productivity : Time taken to complete the course (Note: there is a trade off in this area as some fast times are obtained by dangerous driving these are usually identified by the distance traveled under braking cross referenced with time under braking .

2. Economic driving : Keeping the Rpm in the most fuel efficient Rpm range.

3. Braking : Indicates skill at reading the road ahead , accelerator control , speed safety and economic driving .

4. Gear Shifts : Economic driving utilizing the torque of the engine avoiding unnecessary changes .

5. Idling: identifying unnecessary fuel use and engine damage .

The driver variance report is a summary of that data . (Marked 1)

The Percentage Variances in driver performance in report 1 are as follows :

ITEM	OPTIMUM to AVERAGE	OPTIMUM to BEST	OPTIMUM to WORST	BEST to AVERAGE	BEST to WORST
TIME	9.15 %	+	25 %	12 %	29 %
RPM 1440	27 %	+	52 % +	27 %	52 %
RPM 1920	337 %	+	991 % +	337 %	991 %
BRAKE APP	100 %	42 %	150 %	41 %	76 %
BRAKE % DIST.	188 %	32 %	235 %	118 %	153 %
GEAR SHIFTS	66 %	12.5 %	137 %	47 %	111 %
IDLE TIME	177 %	39 %	397 %	99 %	257 %

The variances above show clearly the potential for saving .

Reports numbered 2 to 6 are compositions from file numbers 4H - 4E - 3 B and present good comparisons of the actual data as recorded by Silent Witness .

Report 2 is summary data : Note total road time : Idle time : Equivalent Idle Distance

Report 3 is a graphed comparison of Rpm Ranges (Ranges Are rounded to nearest 100 rpm) Note The amount of time in the high fuel range above 1700 for both 4H and 3B

Report 4 - 5 - 6 are the graphs of the first ten minutes of the test course in detail.
Note Speeds ranges are on the left side of graph as are the items we are monitoring i.e. brakes , gear changes etc. . The scale at top of the graph shows the date 04 : time 14:04 :00 in hours minutes seconds and continues across the page in one minute blocks .
Note The small break in the key line on report 4 at 14:04:45 this is a vehicle fault and shows the key was off for approx 2 seconds .
Note the very short left turn signal at 14:07:13 (report 7 shows this in detail) .

BELL TRANSPORT DEVELOPMENT : DRIVER VARIANCE REPORT

Test : Hutt Valley Polytech 13 km. course : Vehicle : 1418 Mercedes tractor and semi trailer
Drivers : All experianced : Vehicle monitoring system : Silent Witness SW- 100
For comparison purposes the optimum is Driver Trainer Grant Childs Run File ID. 4I

ROAD TIME	% OF TIME IN RPM RANGE 1030 — 1440 — 1630 — + 1920				NUM. APP.	BRAKE TIME	BRAKE KM.	% OF DIST.	GEAR SHIFTS	IDLE TIME	FILE ID.
M : S	%	%	%	%							
24.35					12	1.47	.22	1.7	32	1.2	4I
23.44	21.3	24.8	28.4	10.5 *	18	1.27	.47	3.6	36	1.51	4H
24.02	12.6	21.2	29.9	16.6	17	1.52	.48	3.7	46	3.41 *	3F
25.18	22.6	28.3	18.5	4.8	26	3.11	.72	5.6	46	4.38	4B
25.22	23.3	21.9	21.9	7.9	27	2.00	.63	4.9 *	55	3.59	4C
26.00	26.5	20.0	20.5	16.4	24 *	3.39	.66	5.1	52	2.41	3D
26.33	28.7	21.3 *	23.2	5.4	17	1.29	.32	2.5	68	2.46	4F
26.50 *	27.	29.3	17.0	2.4	30	3.18	.64	4.9	49	3.29	4E
27.12	13.	15.3	17.	17.1	28	2.15	.78	6.	52	5.12	3G
27.17	24.4	21.2	15.1	14.9	21	2.07	.43	3.3	76	3.28	3E
28.10	27.3	22.3	25.	4.5	26	1.44	.47	3.6	53 *	2.07	4G
28.19 *	14.1	18.1	12.6	26.2	27	2.00	.63	4.9 *	64	6.37	3B
29.19	26.9	14.	21.2	6.7	26	2.58	.64	4.9 *	37	2.36	4D
30.41	29.6	20.4	13.6	11.	29	2.44	.74	5.7	64	3.23	3C

KEY : OPTIMUM = FILE 4 I
BEST =
AVERAGE = *
WORST =

File Name: 1000[redacted].KBH
GPIP Name: HVP2.CAR
Vehicle : HVP1000
From: [redacted] 1991 at 13:59:02
To: [redacted] 1991 at 14:32:01
Driver:

Trip Summary Report

Total Time 0:00:26:32	Total Distance 13 km	Ignition On 2 Times
Road Time 0:00:23:41	Rolling Time 0:00:00:03	* Total Road Time 0:00:23:44
Time Parked 0:00:00:57	Idle Time 0:00:01:51	Total Stop Time 0:00:02:48

Equivalent Idle Distance: 3.95 km

TIME TO COMPLETE COURSE

File Name: 1000[redacted].KBE
GPIP Name: HVP2.CAR
Vehicle : HVP1000
From: [redacted] 1991 at 11:08:15
To: [redacted] 1991 at 12:05:29
Driver:

Trip Summary Report

Total Time 0:00:34:49	Total Distance 13 km	Ignition On 1 Times
Road Time 0:00:26:50	Rolling Time 0:00:00:00	Total Road Time 0:00:26:50
Time Parked 0:00:04:30	Idle Time 0:00:03:29	Total Stop Time 0:00:07:59

Equivalent Idle Distance: 7.43 km

File Name: 1000[redacted].KBB
GPIP Name: HVP2.CAR
Vehicle : HVP1000
From: [redacted] 1991 at 09:06:16
To: [redacted] 1991 at 10:59:09
Driver:

Trip Summary Report

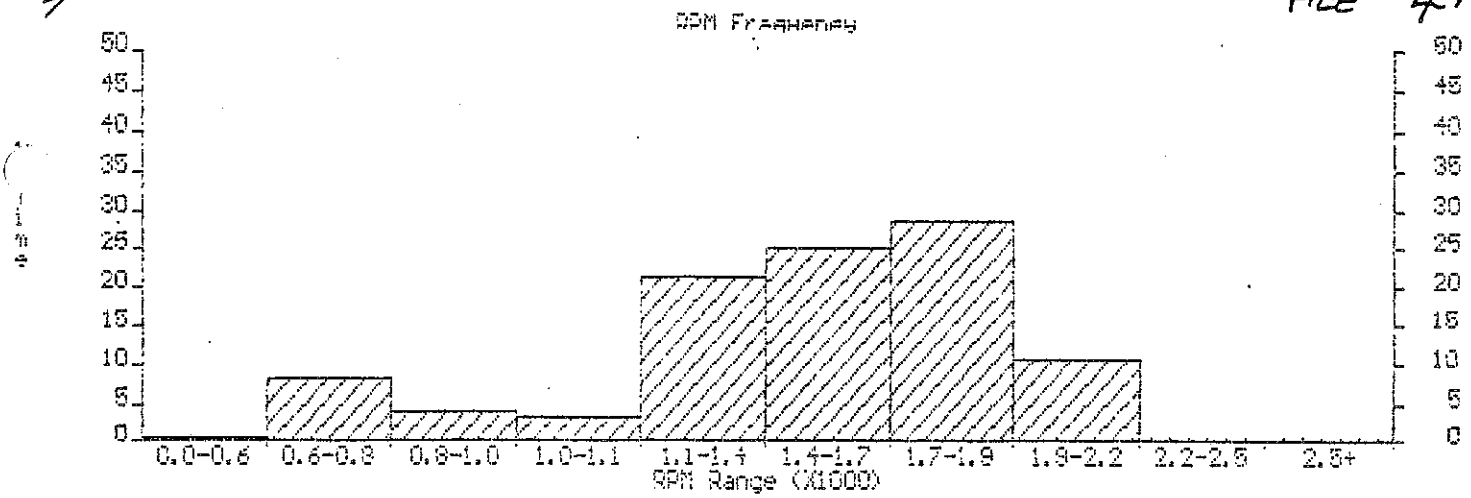
Total Time 0:01:48:41	Total Distance 13 km	Ignition On 1 Times
Road Time 0:00:28:17	Rolling Time 0:00:00:02	Total Road Time 0:00:28:19
Time Parked 0:01:13:45	Idle Time 0:00:06:37	Total Stop Time 0:01:20:22

Equivalent Idle Distance: 14.12 km

AT 1 HR. IDLE = TO 180 KM. OF ENGINE DRIVING TIME.

3/

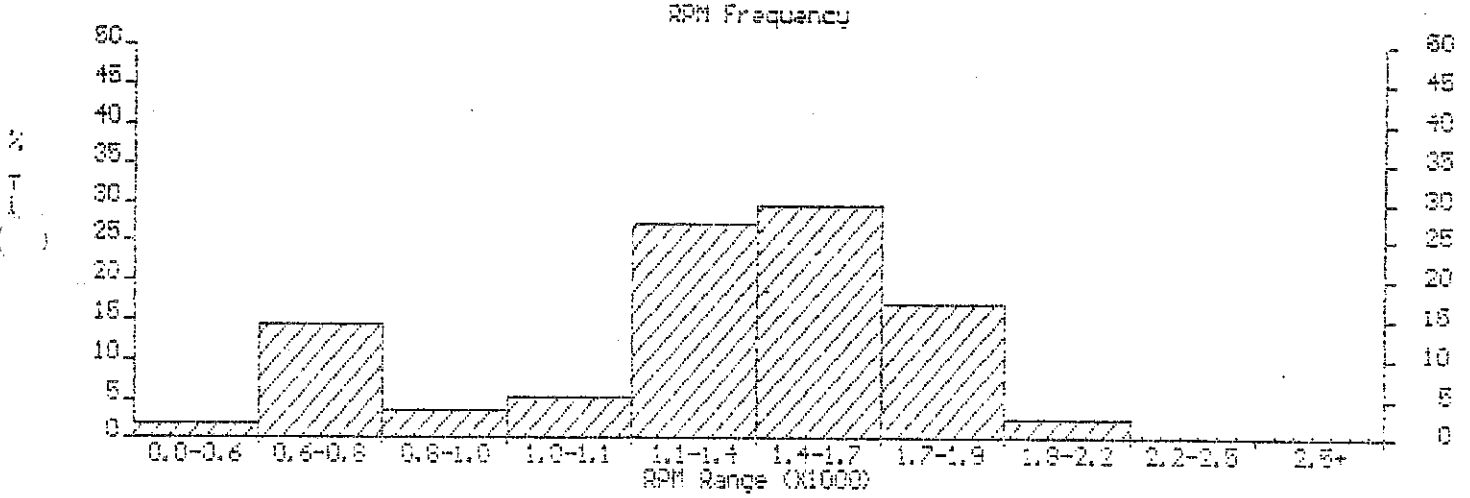
FILE 4H



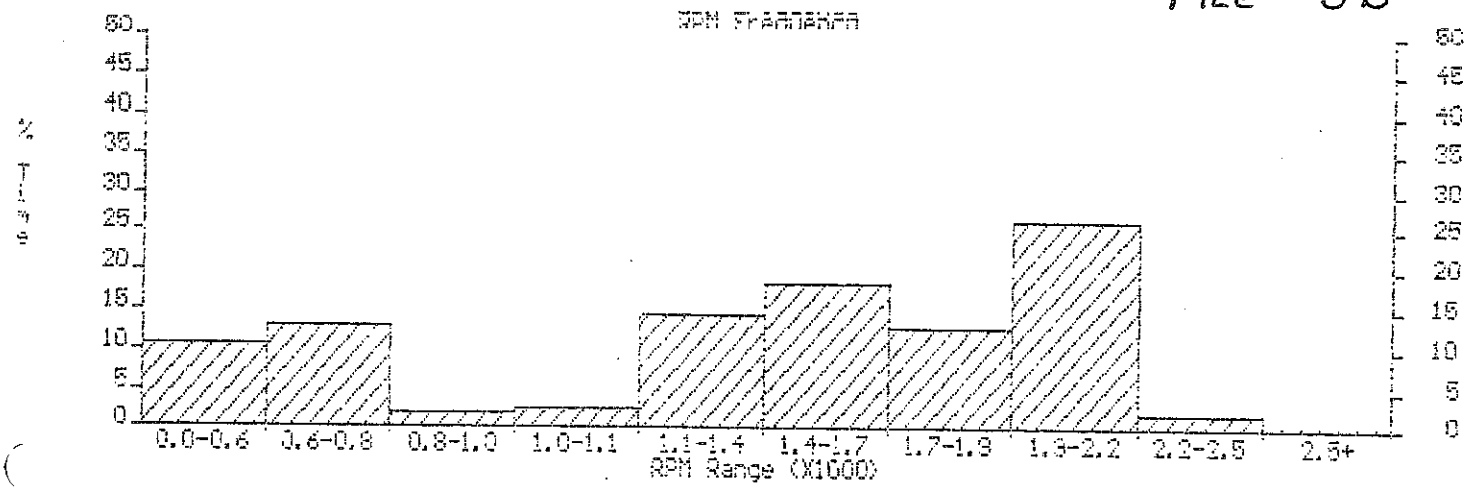
Mar 1 1992

FILE 4E.

12:38:46



FILE 3B.



4 4W.

Silent Witness Enterprises

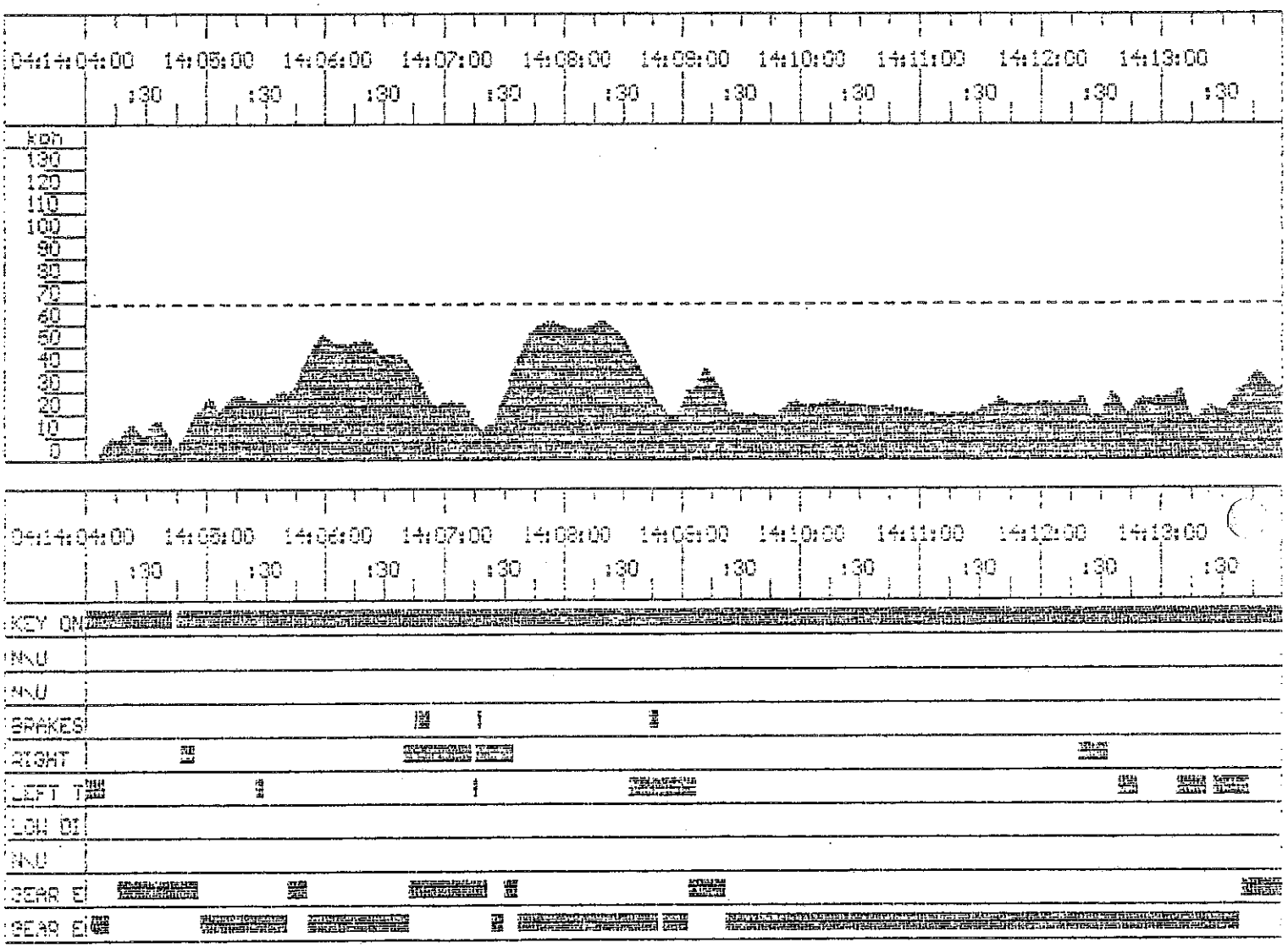
BELL TRANSPORT DEVELOPMENT

Date Printed: Mar 1 1992 at 12:35:39

Data File: 1000[redacted].KBH
SPIP File: HVP2.CAR
Vehicle : HVP1000

StartTime: [redacted] 1991 at 13:58:59
EndTime: [redacted] 1991 at 14:32:01

10 Minute Second By Second Graph



5

4E

Silent Witness Enterprises

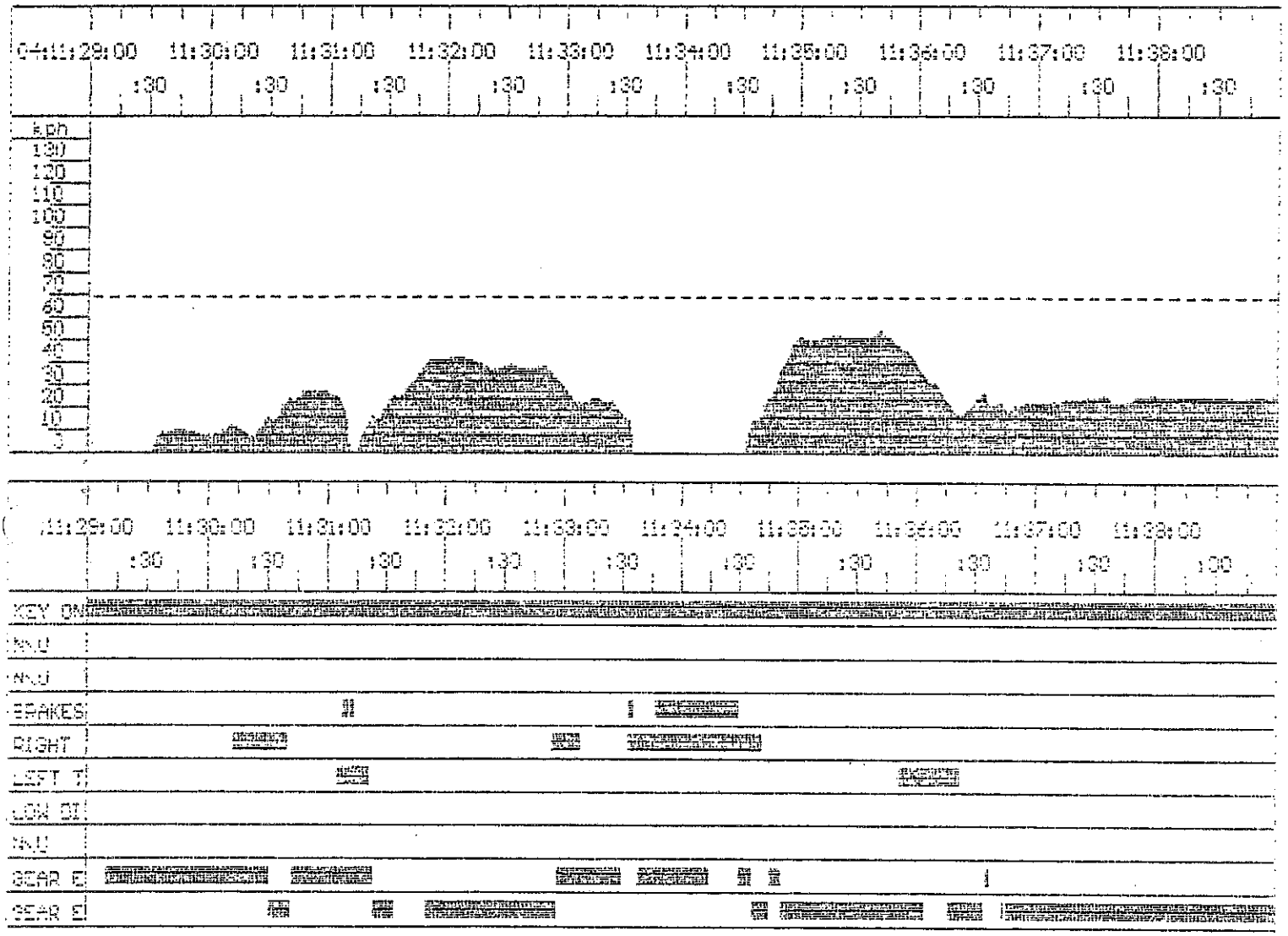
BELL TRANSPORT DEVELOPMENT

Date Printed: Mar 1 1992 at 12:42:29

Data File: 1000D[redacted].K2E
GPIP File: HVP2.CAR
Vehicle : HVP1000

StartTime: [redacted] 1991 at 11:08:12
EndTime: [redacted] 1991 at 12:05:29

10 Minute Second By Second Graph



Silent Witness Enterprises

3B.

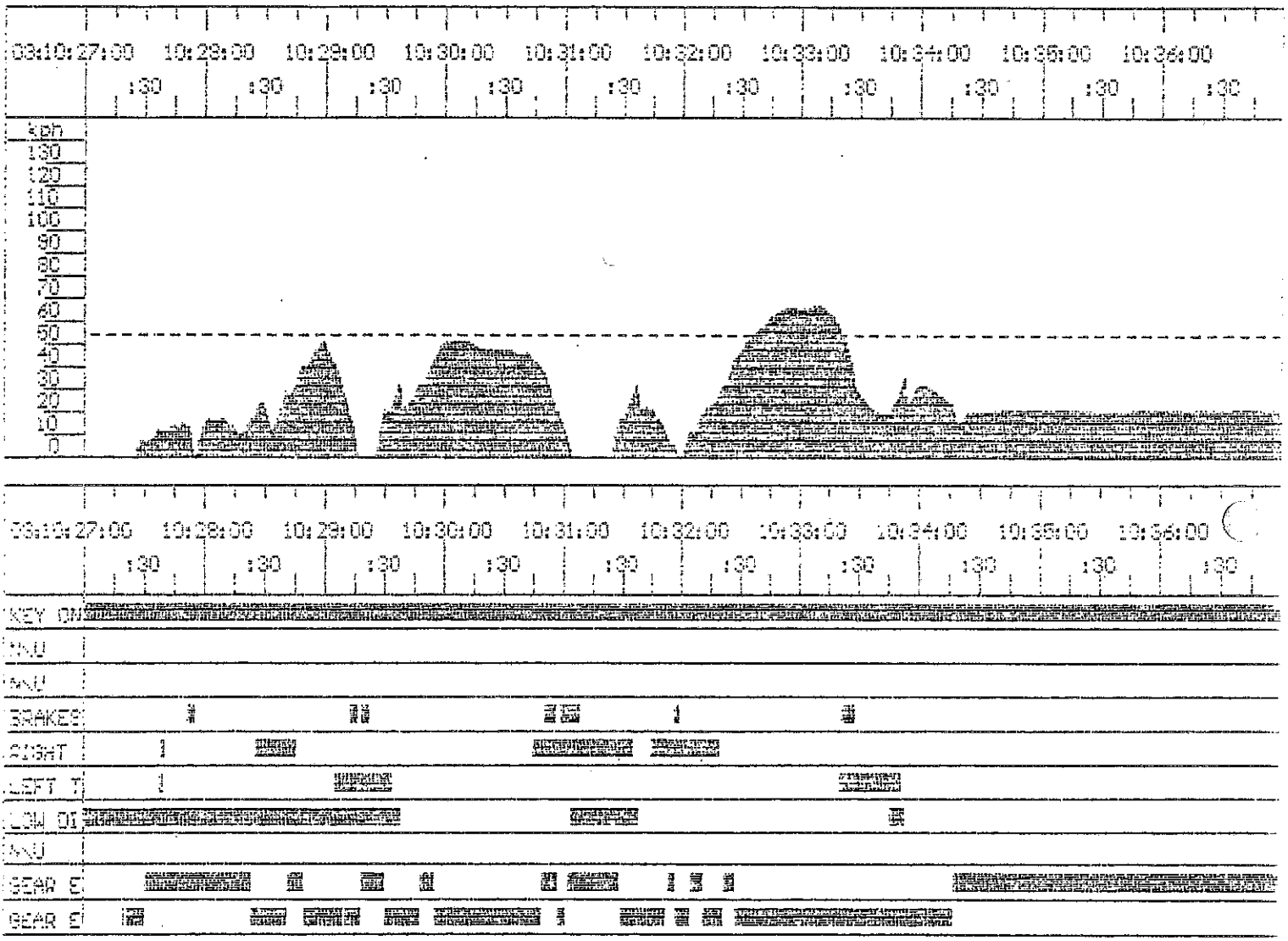
BELL TRANSPORT DEVELOPMENT

Date Printed: Mar 1 1992 at 12:50:16

Data File: 1000D[redacted].KBB
GPIP File: HVP2.CAR
Vehicle : HVP1000

StartTime: [redacted] 1991 at 09:06:12
EndTime: [redacted] 1991 at 10:59:09

10 Minute Second By Second Graph



Silent Witness Enterprises

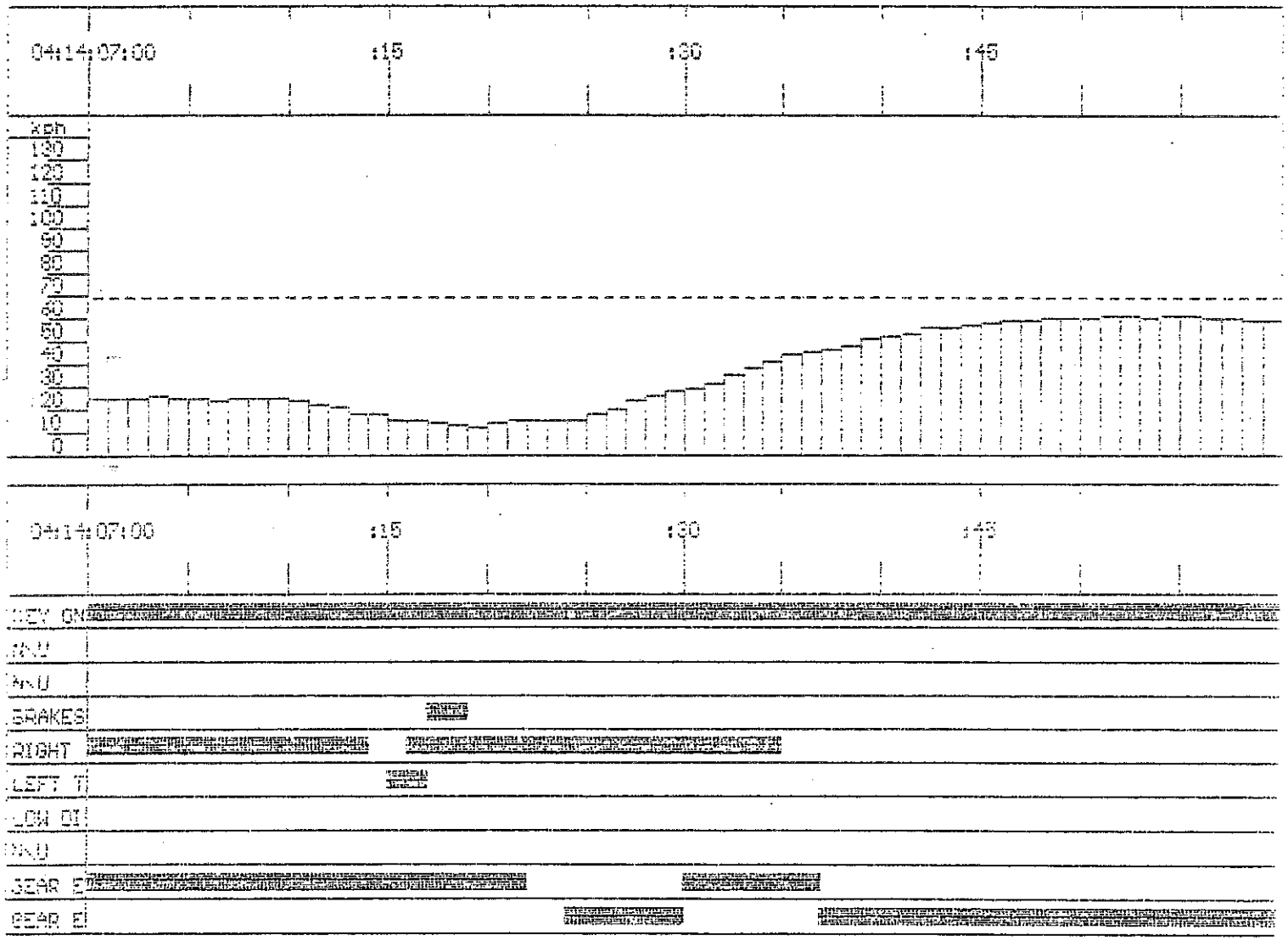
BELL TRANSPORT DEVELOPMENT

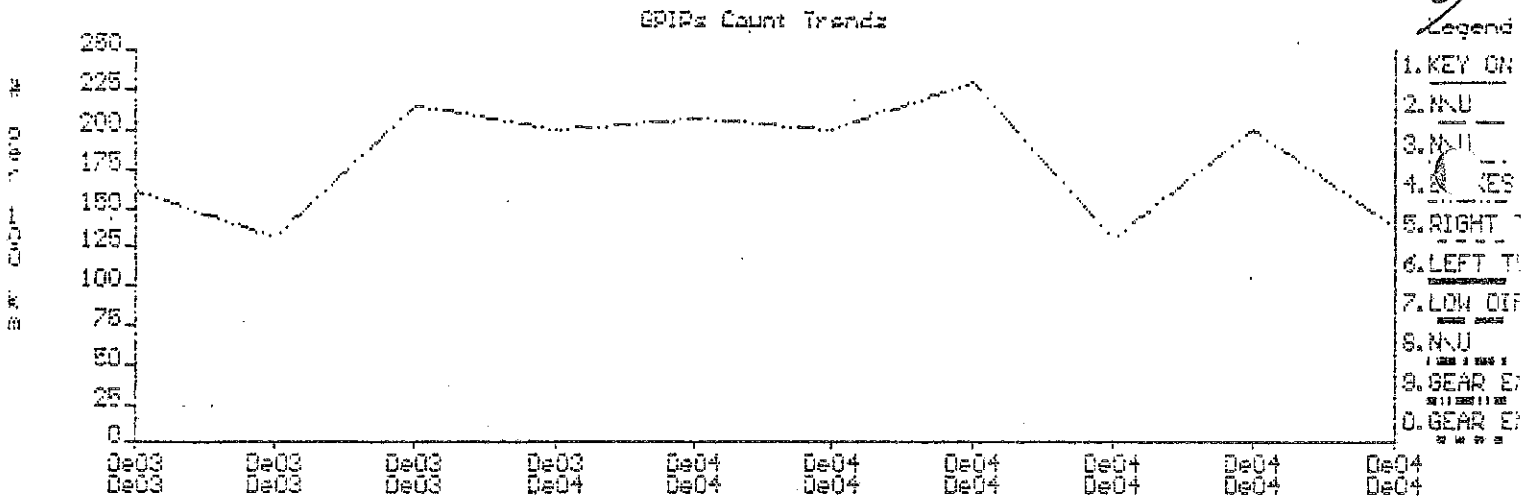
Date Printed: Mar 1 1992 at 12:33:47

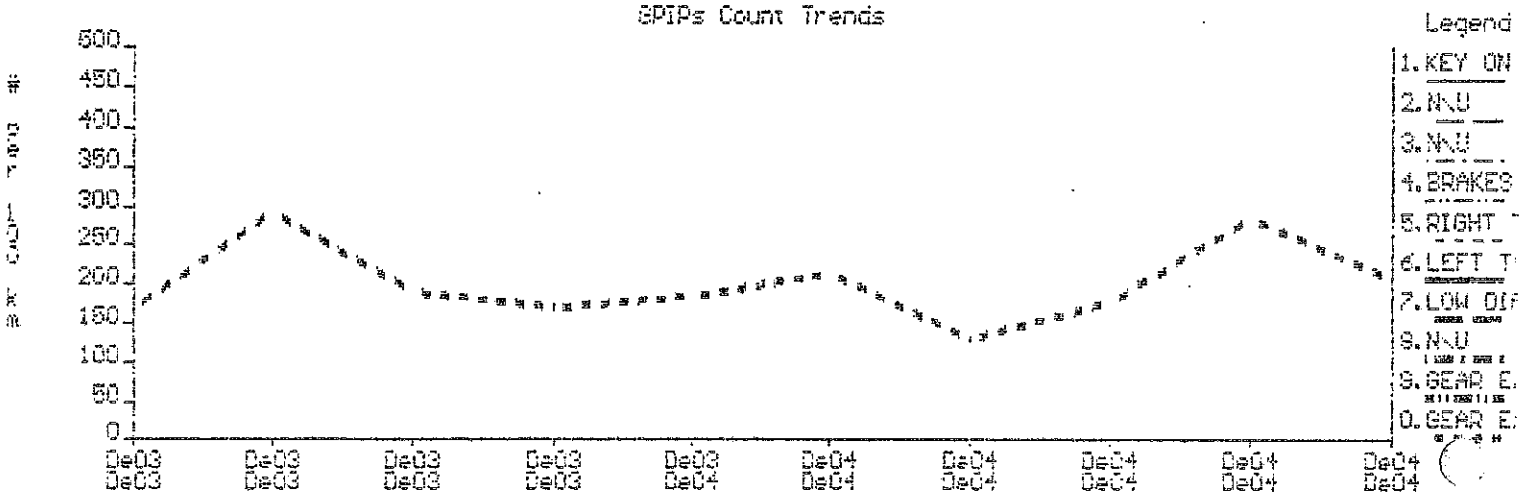
Data File: 10001[redacted]4.KBH
GPIP File: HVP2.CAR
Vehicle : HVP1000

StartTime: [redacted] 1991 at 13:58:59
EndTime: [redacted] 1991 at 14:32:01

1 Minute Second By Second Graph







Summary File: 1000Fe26.SUM
Downloads: 13
Distance: 169 km

From: Dec 3 1991 at 09:06:16
To: Dec 4 1991 at 14:32:01
Total Time: 11.4 hrs

GPIPs Count Trends (# per 100 km)

Period	BRAK	LOW	GEAR	OEAR
De03 De03	207.7	23.1	223.1	269.2
De03 De03	223.1	0.0	207.7	284.6
De03 De03	184.6	7.7	223.1	169.2
De03 De03	161.5	0.0	292.3	292.3
De03 De03	130.8	0.0	161.5	192.3
De03 De03	215.4	15.4	215.4	169.2
De03 De04	200.0	7.7	161.5	184.6
De04 De04	207.7	0.0	207.7	215.4
De04 De04	200.0	0.0	153.8	130.8
De04 De04	230.8	0.0	200.0	176.9
De04 De04	130.8	0.0	238.5	284.6
De04 De04	200.0	0.0	200.0	207.7
De04 De04	138.5	0.0	130.8	146.2

The speed graph shows that he did not stop during this period unlike the others .

Report 6 shows that he reached top speed of 70 kph compared with 52 kph for report 5 and 60 for report 4 , this indicates he is a high speed racer type driver ,when his high number of gear changes and high rpm above 1700 are taken into account .
The interesting point is that this style of driving did not make the fastest time for the course it was third slowest of the group of 13 driver proving The stop -go high speed type of driving does not get you there any faster - It just costs you more :

I estimate for a heavy truck (41 -44 tonne gross) doing round 200000 kilometers per year the cost saving between the best and worst case will be in $35000 N.Z..

Report number 8 is a graph of the trends of operation of brakes (Top Graph) and half the Gear count (bottom graph) on a trends per 100 km basis , this is from 10 of the 13 drivers tested . Note the High Brake Applications and no of gear changes .

---------- Trip Summary Report ----------

Total Time	Total Distance	Ignition On
22:03:05:33	8051 km	274 Times

Road Time	Rolling Time	Total Road Time
5:03:11:46	0:00:00:08	5:03:11:54

Time Parked	Idle Time	Total Stop Time
15:20:46:04	1:03:07:35	16:23:53:39

Equivalent Idle Distance: 3472.18 km

MAJOR COST

SHOULD STRIVE FOR A MAJOR INCREASE IN UTILIZATION

---------- Stops and Idles ----------

	Stops	Idles
Number Recorded:	207	120
Number Collected:	229	121
Set Minimum Time:	0:00:05:00	0:00:03:00
Longest:	2:12:20:03	0:00:26:26
Average:	0:01:50:26	0:00:06:22

MORE MEMORY REQ

REDUCE NO OF IDLES AND MAST GOES DOWN REDUCE MEMORY NEED OK AT PRESENT

---------- Daily Distance ----------

INCREASE STOP TIME BLOCKS

Dailys Collected	Average Daily Time	Longest Daily Time
23/23	0:05:21:23	0:10:37:39
	Average Daily Distance	Longest Daily Distance
	350 km	778.13 km

Memory allocation OK

---------- Over Speed and RPM ----------

	Over Speed	Over RPM (Moving)	Over RPM (Idling)
Number Recorded:	310	20	1
Number Collected:	972	20	1
Set Minimum Time:	0:00:00:10	0:00:00:05	0:00:00:02
Set Minimum Value:	95 kph	1999 RPM	1511 RPM
Maximum Recorded:	107 kph	2193 RPM	1623 RPM
Average :	99 kph	2106 RPM	1623 RPM
Average Time:	0:00:00:54	0:00:00:15	0:00:00:04

Memory out

---------- Hard Accelerations and Decelerations ----------

	Hard Acceleration	Hard Deceleration
Number Recorded:	0	47
Number Collected:	0	47
Set Minimum Time:	0:00:00:02	0:00:00:02
Set Minimum Value:	253 cm/s/s	-253 cm/s/s
Maximum Recorded:	0 cm/s/s	-505 cm/s/s
Average :	0 cm/s/s	-299 cm/s/s
Average Time:	0:00:00:00	0:00:00:02

PROBLEM

Fleet operations :

At the introduction of vehicle computers into a fleet .

Idling :
Standard is 21% of engine hours Best 15% Worst 27 % this can be reduced very quickly to 3-4% of engine hours .
Saving are : 350 HP . engine burns 5 liters of fuel per hour at idle . A vehicle doing 2200000 kilometers per year will idle approx 980 hrs this can be reduced to 180 hrs in days saving 4000 liters of fuel per year .
We have found idling percentage varies little between coach - truck or machine operations.

Time spent in most economical RPM range :
Standard 20 % of engine hours Best 53 % Worst 10.7 % We have operators now achieving 70 % Fuel Use reductions are in the 15 To 20 Percent range
Note some vehicles are unable to achieve the optimum due to diff ratio restrictions .

Jacobs brake use in the 0 to 5 second application range : Standard = 38 applications per 100 km Best 6 applications per 100 km .

WE have found 1 in 15 drivers are driving close to the economic potential of there vehicles .The Rest cover the whole range of performance similar to report 1.This is due in most cases to lack of training and correct information on vehicle operation , mind sets and ultimately due to lack of management in these areas .

BENEFITS TO THE USER.

My 6 years of experience and reports from users confirm my original assessment of the operating cost reductions that are achievable .

1/ 5% Fitting the equipment and controlling speed , rpm and braking .

2/ 10% By using the above and refining vehicle & combination specification using automatically collected administration data to pay drivers and update other systems . Bringing under control all road operations including the turn round times - utilization - scheduling and setting up driving parameters far each trip combined with driver training .

3/ 15% The above combined with and linked to administration systems for freight tracking product control on board invoicing automatic log books and use of the computers to collect additional information and reduce driver manual input, linking to fleet maintenance systems and vehicle weighing systems .

We have clients in N.Z. Achieving operating cost reductions in excess of 10%

Also reported is a reduction of 75% in accident rate in first year, resulting in a $35000 insurance refund. This exceeded the amount invested in vehicle computers .

The cost benefit ratio is good with pay backs being as low as 3 months.

In summary there is major potential in all fleets for reduction in operating costs with the use of vehicle monitoring systems , sound consulting advice and good management .

Constraints to wide spread use of vehicle monitoring systems :

1/Lack of recognition of the savings potential is the major constraint to wide spread introduction .

2 Fleet managers reluctance to tackle the difficult human relations area of on road driver control and operations overhaul .

2/ Lack of understanding of computers and computer systems . Reluctance to accept and learn new technology .

On our part the constraints have been the lack of response by some to requests for equipment & software enhancements and the learning curve involved with new systems .
To address these constraints we are now active in the development of systems in conjunction with our suppliers .

DEVELOPMENT OF VEHICLE MONITORING SYSTEMS IN N.Z.

This section of the paper is to inform you of the development projects we are involved in :

SOFTWARE :

We have started a series of enhancements to the Ultralog software that combine a number of reports into one simplifying analysis and reducing the time taken to process the data .
Stage one has been completed : This verifies driver key pad entries and enables editing before data is added to data base .
Stage two will be completed this week .This will present data on driver wages information in a format ready to be interfaced with payroll programs
Stage three is scheduled for completion end of march . It establishes database for customers ,loading times , total loads and delay times .
Stage Four which is a work scheduling program is also the core program for our new software program that will take data from all the vehicle computers we support and others that supply there record layout . It will enable a operator to run a mix of vehicle computers . i.e. Ultralog for double shift heavy trucks , Silent Witness for single shift heavy trucks and forklifts log loader etc. and Triptrac for medium -light trucks and cars .

The work scheduling program will establish standard and optimum trip performance data and actual trip performance will be measured against this on a plus minus trend basis enabling absolute on the road control . This program will also handle weighbill and manifest information if required and interface will be available to most accounting and fleet maintenance programs .

HARDWARE

We have obtained the technology for a new vehicle computer TRIPTRAC . This unit records speed ,rpm , stops , starts , idles , log book functions and running costs It also advises when selected maintenance items are due and records completion .It is designed for light to medium trucks , coach & bus operation. We expect to introduce a car model late this year. We are manufacturing this unit in Hamilton .

The ULTRALOG system was the result of discussions between us and a group of three expatriate New Zealanders based in Brisbane Australia . The aim was to produce the ultimate in vehicle computers , a open system using the latest in chip technology to which a large range of options could be added . Utilizing a software development program that would enable customizing at reasonable cost .

This was achieved within 12 months of the original discussion .
We had the first fleet installed with ultralog and infra red debriefing operating in N.Z. 10 months after these discussions .

Options now available are data transfer by radio telephone.
Location by satellite global positioning .
Bar code readers for freight tracking
Interface with on board scale systems.

Systems in development stage :
Log book systems using the ultracard .
Each driver has a ultralog card that contains the last ten days of driving records. This is transferred to Ultralog along with drivers ID at start of shift and up dated at end of shift it may also be debriefed and printed at any time with appropriate card reader or the ultralog vehicle unit can be interrogated by activating the appropriate key.

Specification have been draw up for a **Road User Charges recording system.**
RUC information consisting of reference number, weight , km. start and finish for truck trailers (using hubo readings) can be keyed in or transferred by data modem these can then be incremented by the vehicle computer . The unit can also be attached to on board scales advising office P.C. of weights at start of journey , RUC is brought for journey and reference details transferred to vehicle computer . As the load is increased or decreased with loading & unloading on journey RUC required can be adjusted by direct purchase through office P.C.

As per our specification and know how we now offer a top speed limiter option with all our vehicle computers using - stop or throttle control actuators .

Field trials will commence this month on a new Infra Red debriefing system developed to our specification . This unit will operate with Silent Witness and any other compatible electronic recording systems . It has the capability of switching between two recording devices on the same vehicle and debriefing both .

We would like to see the infra red system incorporated in fuel stop facilities this would , enable recognition of the vehicle for authorization to draw fuel and automatic transfer of odometer reading . The vehicle computer could also be debriefed at the same time and data transferred by modem to owners P.C. .

I trust this has informed you of the effort we are making to assist the transport industry .

Rory Bell
01/03/92