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Report

TARRAWONGA COAL MINE PRP U1: MONITORING RESULTS – WHEEL GENERATED DUST

TARRAWONGA COAL PTY LTD

Job ID. 07487a

29 July 2014

PROJECT NAME:	Tarrawonga Coal Mine PRP U1: Monitoring Results – Wheel Generated Dust
JOB ID:	07487a
DOCUMENT CONTROL NUMBER	AQU-NW-001-07487a
PREPARED FOR:	Tarrawonga Coal Pty Ltd
APPROVED FOR RELEASE BY:	Judith Cox
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DOCUMENT CONTROL			
VERSION	**DATE**	**PREPARED BY**	**REVIEWED BY**
D1	23.07.2014	Greer Laing	Judith Cox
FINAL	29.07.2014	Greer Laing	

Pacific Environment Operations Pty Ltd: ABN 86 127 101 642

BRISBANE
Level 1, 59 Melbourne Street, South Brisbane Qld 4101
PO Box 3306, South Brisbane Qld 4101
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

Unit 1, 22 Varley Street
Yeerongpilly, Qld 4105
Ph: +61 7 3004 6460

ADELAIDE
35 Edward Street, Norwood SA 5067
PO Box 3187, Norwood SA 5067
Ph: +61 8 8332 0960
Fax: +61 7 3844 5858

SYDNEY
Suite 1, Level 1, 146 Arthur Street
North Sydney, NSW 2060
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

MELBOURNE
Level 10, 224 Queen Street
Melbourne Vic 3000
Ph: +61 3 9036 2637
Fax: +61 2 9870 0999

PERTH
Level 1, Suite 3
34 Queen Street, Perth WA 6000
Ph: +61 8 9481 4961
Fax: +61 2 9870 0999

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1 INTRODUCTION

Tarrawonga Coal Pty Ltd (TCPL) holds Environmental Protection Licence (EPL) 12365 for the Tarrawonga Coal Mine (TCM). Condition U1 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust)* requires that TCPL must achieve and maintain a dust control efficiency of 80% or more on its haul roads.

To satisfy the requirements of the EPL, a Monitoring Plan was developed for condition U1 which outlined the proposed monitoring method to determine the site wide haul road control efficiency (**Pacific Environment, 2013a**).

This report provides results from the haul road dust control efficiency monitoring for Tarrawonga Coal Mine.

1.1 Licence Requirements

Condition U1.1 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust)* requires that TCM must achieve and maintain a dust control efficiency of 80% or more on its haul roads. Control efficiency is calculated as:

$$CE = \frac{E_{uncontrolled} - E_{controlled}}{E_{uncontrolled}} \times 100$$

Where

E = measured emissions (mg/m^3).

Condition U1.2 requires that to assess compliance with U1.1, TCM must:

- Measure uncontrolled and controlled haul road emissions on at least 3 occasions using a mobile dust monitor.
- Continuously measure and record additional site data including:
  - Vehicle kilometres travelled (VKT)
  - Meteorological conditions
  - Water use for dust suppression
- Undertake silt content and soil moisture sampling during sampling events.
- Determine if a site specific relationship can be derived between the measured control efficiency, additional site data, water use, meteorological data, and silt content and soil moisture levels.

The measurement of controlled and uncontrolled haul road dust emissions must be undertaken under varying meteorological conditions, including at times when analysis of meteorological data indicated that elevate levels of dust are most likely at the site.

2 SAMPLING METHODOLOGY

2.1 Mobile Monitoring

PM_{10} emissions from haul roads were measured using the mobile system REX (Road Emissions eXpert). REX measures the concentration of PM_{10} generated from the test vehicle and so by comparing data collected from haul roads with and without controls, control efficiencies can be calculated.

The monitoring method is described in greater detail in ACARP Project C20023 (**Cox & Laing, in press**). All monitoring was conducted according to the internal Quality Management Plan for the use of REX (**Pacific Environment, 2013**).

2.2 Sampling Approach

All active haul routes on the mine were sampled repeatedly over the sampling day. Within the full active circuit of the mine was an uncontrolled section of road, left at least 12 hours without controls (further details in **Section 2.3**).

2.3 Calculating Control Efficiency

Critical to the determination of haul road dust control efficiency is the definition of what constitutes an 'uncontrolled' section of haul road.

Seasonal changes in meteorology play a large role in the efficiency of controls applied to haul roads to manage wheel-generated dust. Conditions such as rainfall, high humidity, fog or damp are natural controls that reduce dust generated from an unsealed road. Conversely, higher ambient temperatures can cause increased evaporation, requiring more watering or suppressant to be used to meet a sufficient level of control. Road management, construction and maintenance also contribute to controlling dust.

For these reasons, it is not appropriate to calculate a control efficiency using baseline data that is heavily impacted by these seasonal conditions and management factors, where the control efficiency calculated does not have any bearing on the dust being generated (i.e. winter control efficiency being much lower than summer control efficiency). Therefore, the maximum uncontrolled data collected over all monitoring campaigns has been used to reflect an uncontrolled baseline and applied across the year to calculate the control efficiency.

For the purposes of determination of control efficiency, we define an uncontrolled haul road as:

> *"A section of at least 150 m of an active haul road where no water has been applied for at least 12 hours prior to monitoring and hasn't been treated with chemical suppressant. Less than 0.3 mm of precipitation has been recorded at the closest meteorological station in the preceding 12 hours and ambient conditions during monitoring do not act to suppress dust (rainfall, fog, mist, high humidity, low evaporation, low wind speeds)."*

3 RESULTS

In accordance with condition U1, two rounds of REX monitoring have been completed during July 2013 and February 2014. The results of the monitoring are shown in following sections:

- Dust control efficiency achieved on the sampling days (**Section 3.1**)
- Dust concentrations measured (**Section 3.2**)
- Additional site data, including meteorological conditions, operational factors and the results of silt and moisture sampling (**Section 3.3**)
- Site specific relationships between these data (**Section 3.4**)

3.1 Dust Control Efficiency

The average control efficiency achieved during the monitoring was calculated as 92 %. Average control efficiency achieved during each sampling campaign and the range by circuit is shown in **Table 3.1**.

Table 3.1: Summary of REX control efficiencies

Monitoring Round	Sampling Date	Number of circuits of the active mine	Average Control Efficiency	Range of Control Efficiency by circuit
1	23 July 2013	6	89 %	79 % - 98 %
2	4 February 2014	5	94 %	93 % - 96 %

3.2 Dust Concentrations Measured

The average PM_{10} concentration measured during each sampling campaign is shown in **Table 3.2**.

Table 3.2: Summary of REX measured PM concentration

Monitoring Round	Sampling Date	Average controlled PM_{10} concentration (mg/m^3)	Maximum average uncontrolled PM_{10} concentration (mg/m^3)
1	23 July 2013	0.140	1.270
2	4 February 2014	0.070	

3.3 Additional Site Data

A summary of the meteorological conditions, as recorded by the site meteorological station operating during the sampling day, for the day of each monitoring event is presented in **Table 3.3**. The average control efficiency achieved during each day has been included for comparison.

Table 3.3: Summary statistics for meteorological conditions

Parameter (units)	Round 1	Round 2
Average Wind Speed (m/s)	2.1 m/s	3.7 m/s
Average Temperature (°C)	8.6 °C	26.8 °C
Average Relative Humidity (%)	68.9 %	40.4 %
Average Solar Radiation (W/m^2)	114.3 W/m^2	289 W/m^2
Total Rainfall (mm)	0.00 mm	0.00 mm
Average control efficiency (%)	89 %	94 %

Four and a half years of meteorological data (January 2009 – April 2014) from the Tarrawonga Mine site meteorological station were analysed to determine the seasonal variation in meteorology at the site. **Figure 3.1** to **Figure 3.4** shows the following:

- Average monthly temperature compared to average temperature on sampling day (**Figure 3.1**)
- Average monthly humidity compared to average humidity on sampling days (**Figure 3.2**)
- Average monthly solar radiation compared to average solar radiation on sampling days (**Figure 3.3**)
- Total monthly rainfall by year (**Figure 3.4**)

The analysis shows that the sampling days where monitoring was completed are representative of changing seasonal conditions across the year.

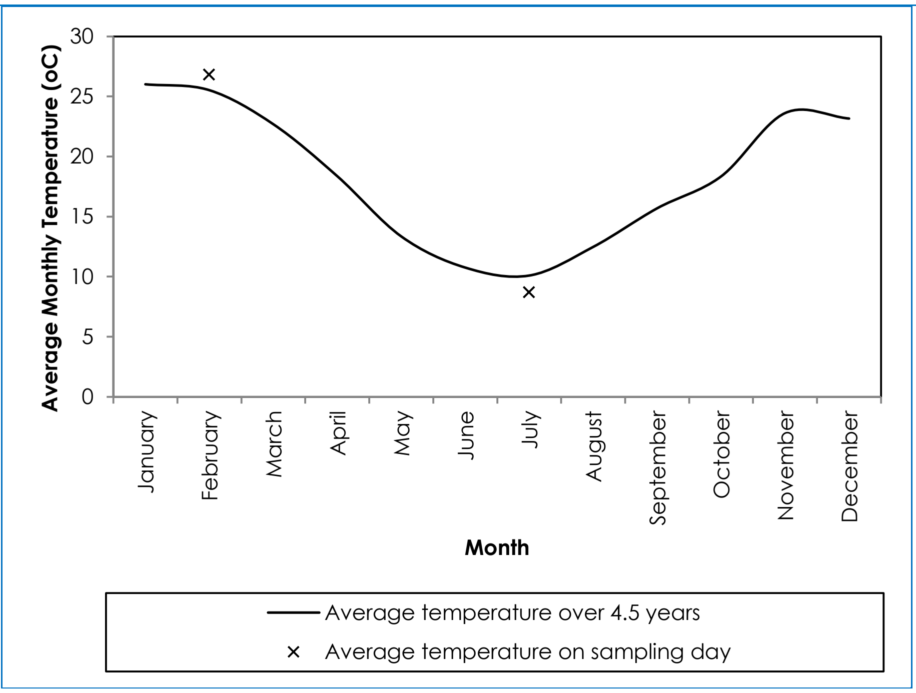

Figure 3.1: Average monthly temperature (°C) from January 2009 – April 2014 compared to average temperature on sampling day

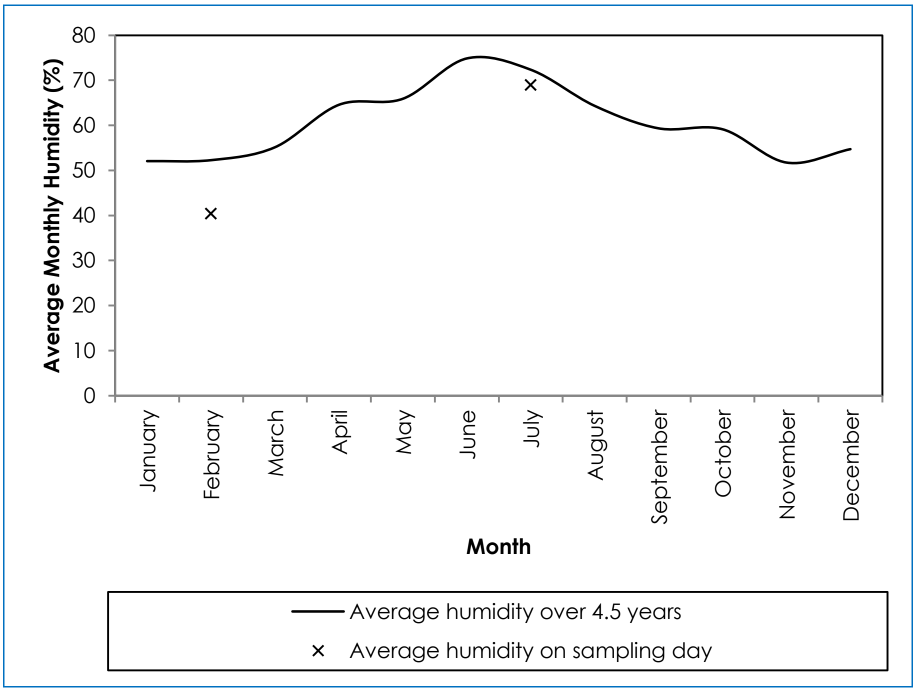

Figure 3.2: Average monthly humidity (%) from January 2009 – April 2014 compared to average humidity on sampling day

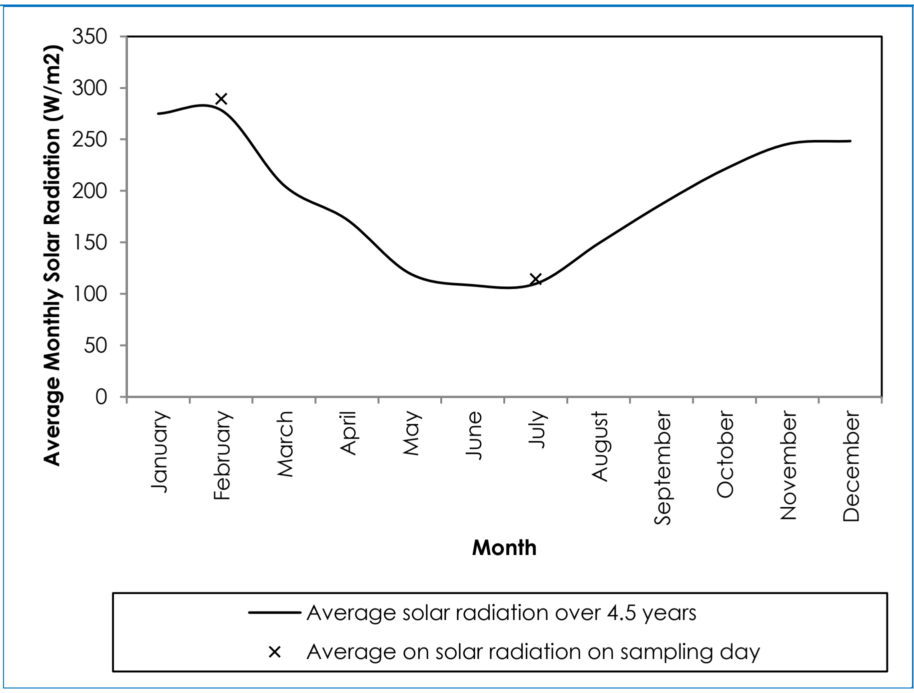

Figure 3.3: Average monthly solar radiation from January 2009 – April 2014 compared to average solar radiation on sampling day

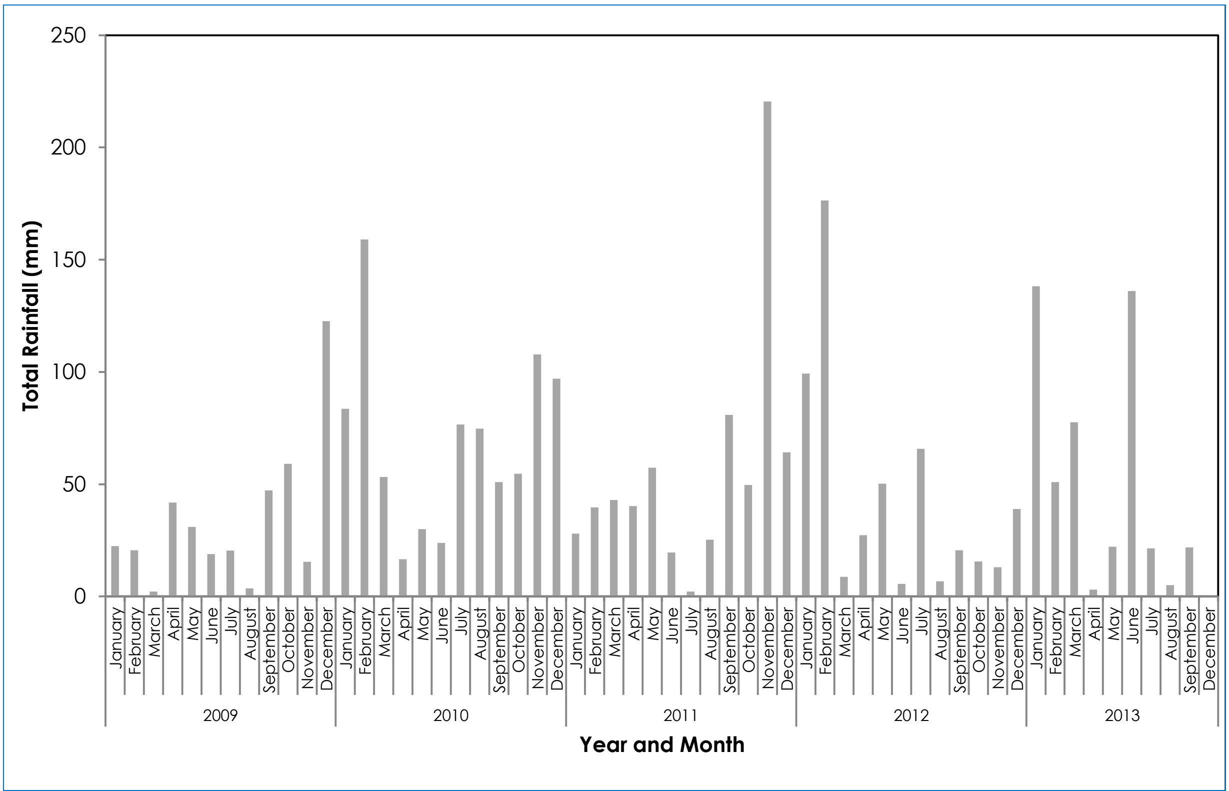

Figure 3.4: Total monthly rainfall (mm) from January 2009 – April 2014

In accordance with condition U1, additional operational data were collected for the periods of monitoring and are summarised in **Figure 3.4**. The majority of operational parameters do not change between monitoring periods.

Table 3.4: Additional site data

Site Data	Monitoring Round 1	Monitoring Round 2
Vehicle movement routes	Ramp 3 pit to dump, Ramp 2 pit to dump	Ramp 3 pit to dump, Ramp 2 pit to dump
Loaded haul truck weight	CAT785C 102 tonne empty, 250 tonne gross operating weight, CAT789C 130 tonne empty, 317 tonne gross operating weight	CAT785C 102 tonne empty, 250 tonne gross operating weight, CAT789C 130 tonne empty, 317 tonne gross operating weight
Vehicle speed	Speed limit 60 km/h	Speed limit 60 km/h
Method of watering	Water	Water
Water application time	Not measured directly	Not measured directly
Water application volume	WAT860 (32,000L) & WAT863 (32,000L)	WAT885 (32,000L), WAT868 (45,000L) & WAT891 (13,000L)
Water application rate	Continuous or as required	Continuous or as required

During each sampling campaign a bulk sample of the road surface was collected in accordance with the surface sampling methodology (**US EPA, 1993**). The samples were analysed at the laboratory for silt and moisture content, these reports are included in **Appendix A**.

Table 3.5: Results of silt and moisture sampling

Monitoring Round	Road Type	Control Level	Silt (%)	Moisture (%)
1	Temporary	Uncontrolled	6.7	2.1
	Temporary	Controlled	1.2	8.3
	Permanent	Controlled	3.6	2.4
2	Temporary	Uncontrolled	2.3	1.3
	Temporary	Controlled	5.1	0.6
	Temporary	Controlled	6.7	2.2

3.4 Site Specific Relationships

No site specific relationships were evident when the average dust concentrations measured were compared against the other site specific parameters. All causal relationships were systematically explored but no parameters were significantly correlated when the control efficiency achieved was compared to meteorological data, operational parameters or silt and moisture content. The relationships were explored for each round and for each circuit of the mine.

Typically the dust concentrations measured is found to correlate with average temperature, relative humidity and solar radiation. These factors should be considered when managing haul road control measures.

4 CONCLUSION

Wheel-generated dust control efficiency was assessed at Tarrawonga Coal Mine on two occasions using a mobile dust monitoring system (REX). The dust control effectiveness was calculated as 89% on 23 July 2013 and 94 % 4 February 2014. On both occasions the site was maintaining an average dust control efficiency of greater than 80%.

A number of factors contribute to dust generation from haul roads. No relationships were evident from the data collected at Tarrawonga, when the data was compared to silt and moisture data, meteorological data and operational parameters.

However, the ACARP study has shown that consideration of site-specific operational factors is critical to minimising the level of dust generated from unsealed roads, including:

- Roads under construction.
- Roads recently graded.
- Coal operation areas.
- Roads adjacent to stockpiles.
- Highly-trafficked areas.

These management measures should be the focus for best practice management of haul road controls.

5 REFERENCES

Cox J and Laing G (in press). *Mobile Sampling of Dust Emissions from Unsealed Roads*. ACARP Project C20023. Stage 2 Final Report.

Pacific Environment (2013a). *Tarrawonga Coal Pollution Reduction Monitoring Plan – U1 Wheel Generated Dust*. 25 July 2013.

Pacific Environment (2013b). *Quality Management Plan – Mobile Haul Road Monitoring*. 03 January 2013.

US EPA (1993). *Procedures for Sampling Surface/Bulk Dust Loading*. Appendix C.1. AP-42.

Appendix A SILT AND MOISTURE SAMPLING RESULTS

A.1 JULY 2013 SILT AND MOISTURE SAMPLING RESULTS

Job Number : L107252
Client : Pacific Environment Limited
Reference/Order : 7274
Project : Tarrawonga

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		Lab No	001	002	003
		Sample ID			
Analyte		DL			
NQ968 - Moisture Determination of Bulk Samples					
Total Moisture (@ 105o C)	%	0.1	1.3	0.60	2.2
NQ899 - Size Analysis of Misc.Material					
+ 31.5 mm	%	0.1	10.5	nd	nd
-31.5 + 16.0 mm	%	0.1	16.4	13.9	6.1
-16.0 + 8.0 mm	%	0.1	24.0	10.6	10.6
-8.0 + 4.0 mm	%	0.1	12.0	12.2	13.2
-4.0 + 0.85 mm	%	0.1	16.1	25.7	27.1
-0.85 + 0.425 mm	%	0.1	7.4	13.1	13.9
-0.425 + 0.150 mm	%	0.1	7.6	13.8	15.8
-0.150 + 0.075 mm	%	0.1	3.7	5.6	6.6
-0.075 mm	%	0.1	2.3	5.1	6.7

DL = Detection Limit
LNR = Samples Listed not Received
-- = Not Applicable
nd = < DL
db = Dry basis

Sample Description Key (if req'd)

001	1. RAMP 3 UNCONTROLLED - HAUL RD
002	2. RAMP 2 UNCONTROLLED - HAUL RD
003	3. 300 DUMP CONTROLLED - HAUL RD

A.2 FEBRUARY 2014 SILT AND MOISTURE SAMPLING RESULTS

Job Number : L104798
Client : Pacific Environment Limited
Reference/Order : 6961
Project : ACARP TARRAWONGA

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		Lab No	001	002	003	004
		Sample ID	1	2	3	4
Analyte		DL	Road Dust	Road Dust	Road Dust	Overburden
PC072 - Bulk Moisture Determination						
Total Moisture (@ 105.C)	%	0.1	2.1	8.3	2.4	5.6
NQ899 - Size Analysis of Misc.Material						
+ 31.5 mm	%	0.1	nd	nd	nd	11.4
-31.5 + 16.0 mm	%	0.1	1.0	17.7	10.5	13.2
-16.0 + 8.0 mm	%	0.1	3.8	22.4	13.5	15.9
-8.0 + 4.0 mm	%	0.1	9.5	21.0	11.8	11.7
-4.0 + 0.85 mm	%	0.1	33.1	24.8	27.5	18.8
-0.85 + 0.425 mm	%	0.1	17.8	6.3	15.3	8.4
-0.425 + 0.150 mm	%	0.1	17.8	5.1	13.8	10.9
-0.150 + 0.075 mm	%	0.1	10.3	1.5	4.0	4.5
-0.075 mm	%	0.1	6.7	1.2	3.6	5.2

DL = Detection Limit
LNR = Samples Listed not Received
-- = Not Applicable
nd = < DL
db = Dry basis

Sample Description Key (if req'd)

001	RAMP 3 UNCONTROLLED 23.7.13
002	LEVEL 300 23.7.13
003	ROM PAD 23.7.13
004	ACTIVE OB 24.7.13