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APPENDIX P

SHUTTLE CAR TRACTION MOTORS

Typical nameplate data for the traction motors of a CM can be seen in Table P-1. The traction motors measured at both sections was a 250 V, 22 kW DC motor with a full load current rating of 102 A.

Table P-1: Nameplate data of traction motor on a SC.

Shuttle car Traction Motors					
Power	22	kW	Voltage	250	V
Duty	S2 - 60		Current	102	A
Ins class	H		RPM	1600	

Table P-2: Production figures for shifts that the traction motor were investigated.

Date	Sect 51		Sect 50	
	Morning	Afternoon	Morning	Afternoon
20-Jun-2005	1200	1890	-	-
21-Jun-2005	**2030**	**2320**	-	-
4-Jul-2005	-	**-**	1800	**2124**

P.1 LOAD PROFILE

The next section focuses on the load profiles of the traction motors. Each graph shows the line voltage and the voltage limits, the load current and full load current capacity of the traction motors. The morning shifts and afternoon shifts are separated as well as the measurements made at the different sections.

P.1.1 SECTION 50

P.1.1.1 Morning shifts

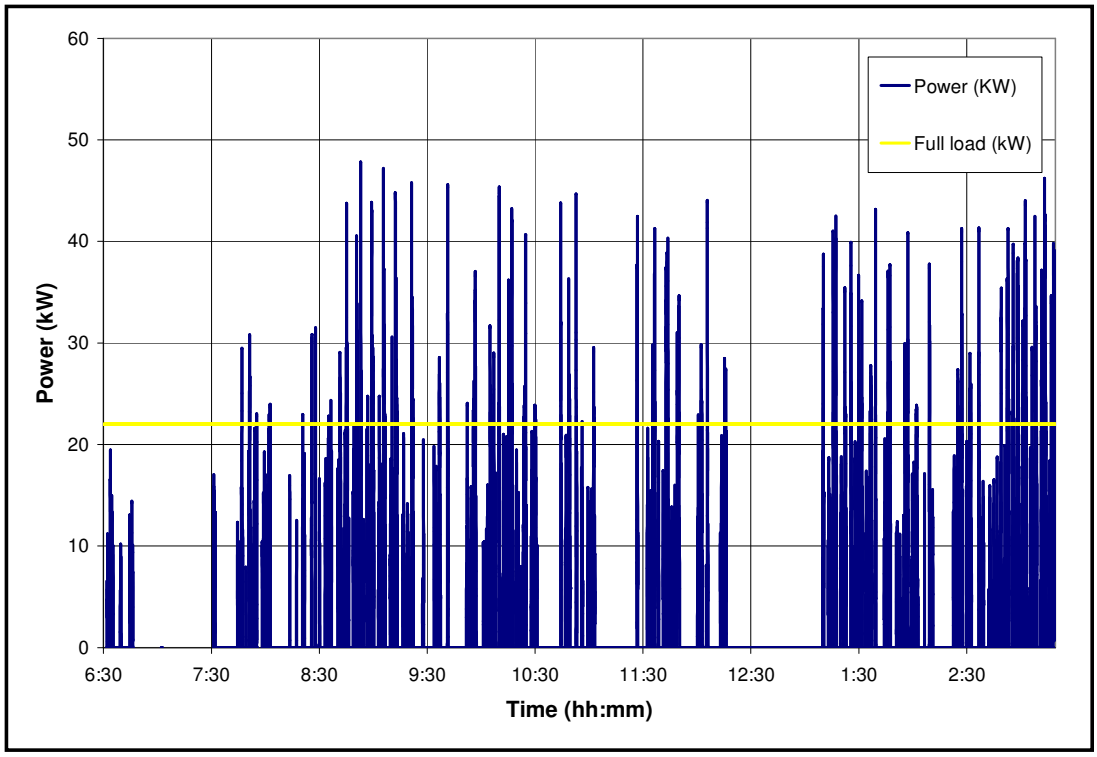

Figure P.1-1: Load power for a LH traction motor – 04 July 2005.

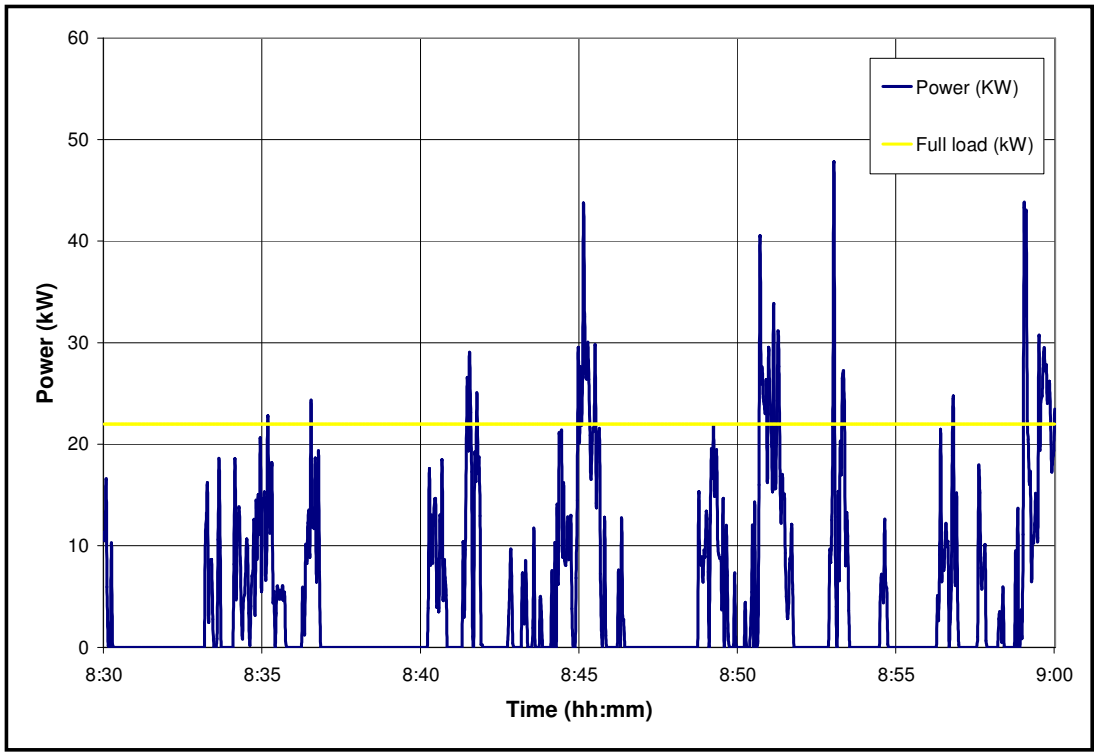

Figure P.1-2: Load power for a LH traction motor – 04 July 2005 (30 minute period).

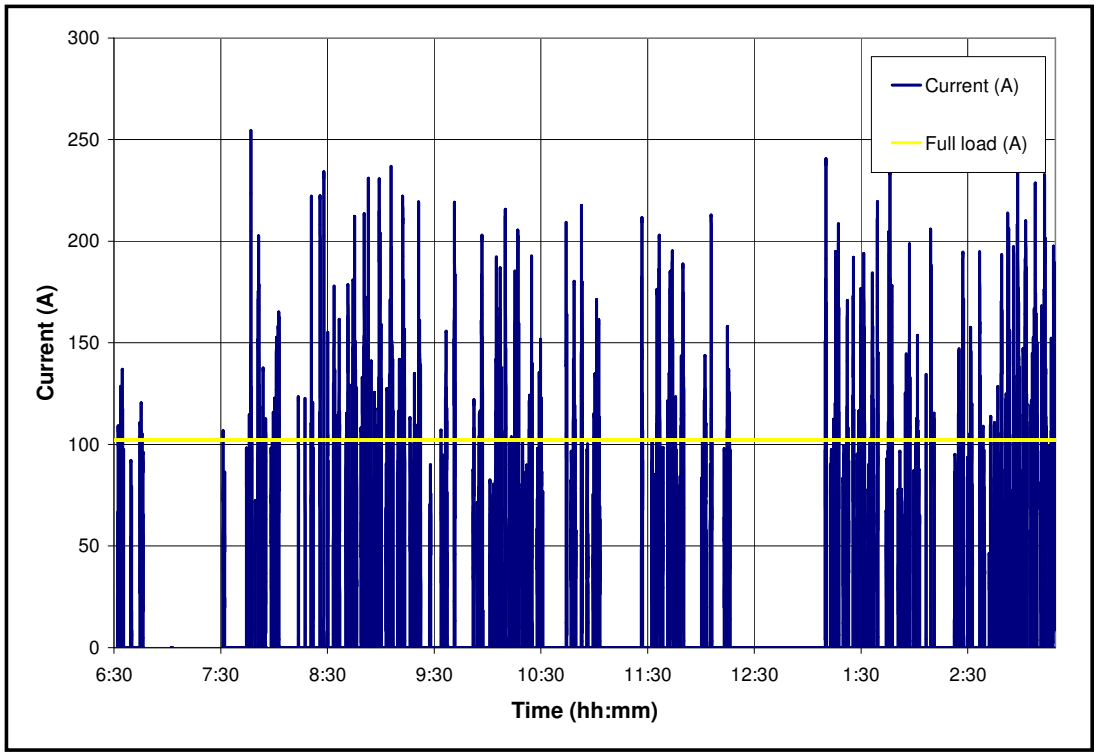

Figure P.1-3: Load current for a LH traction motor – 04 July 2005.

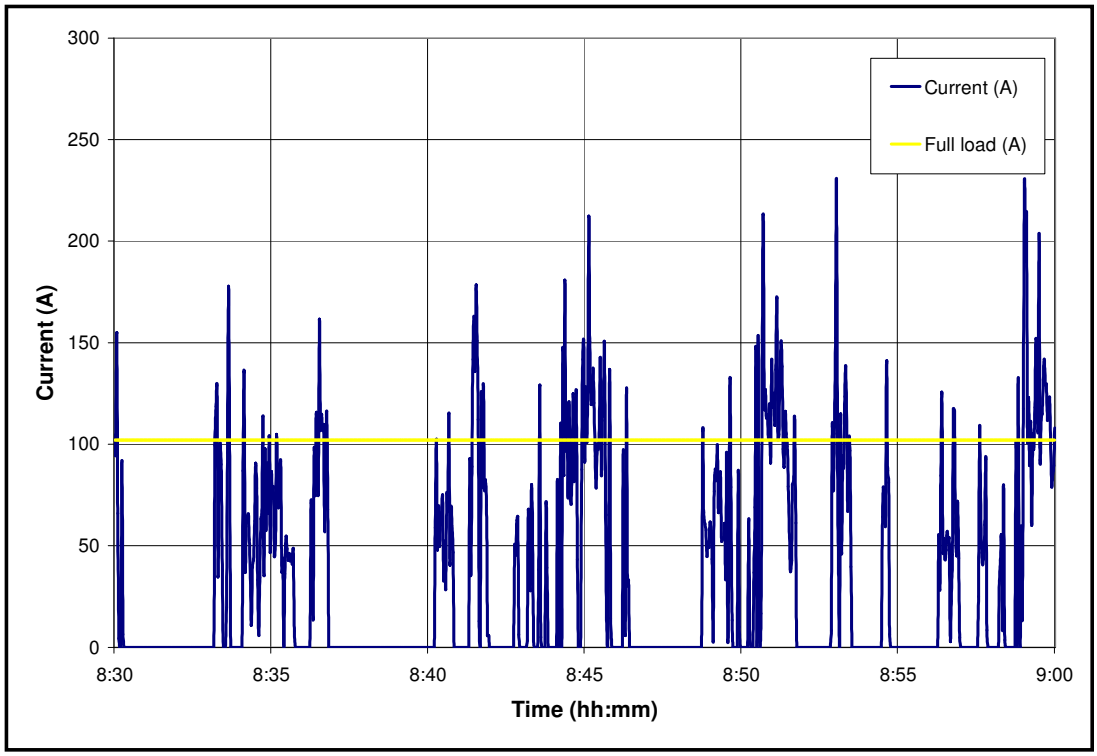

Figure P.1-4: Load current for a LH traction motor – 04 July 2005 (30 minute period).

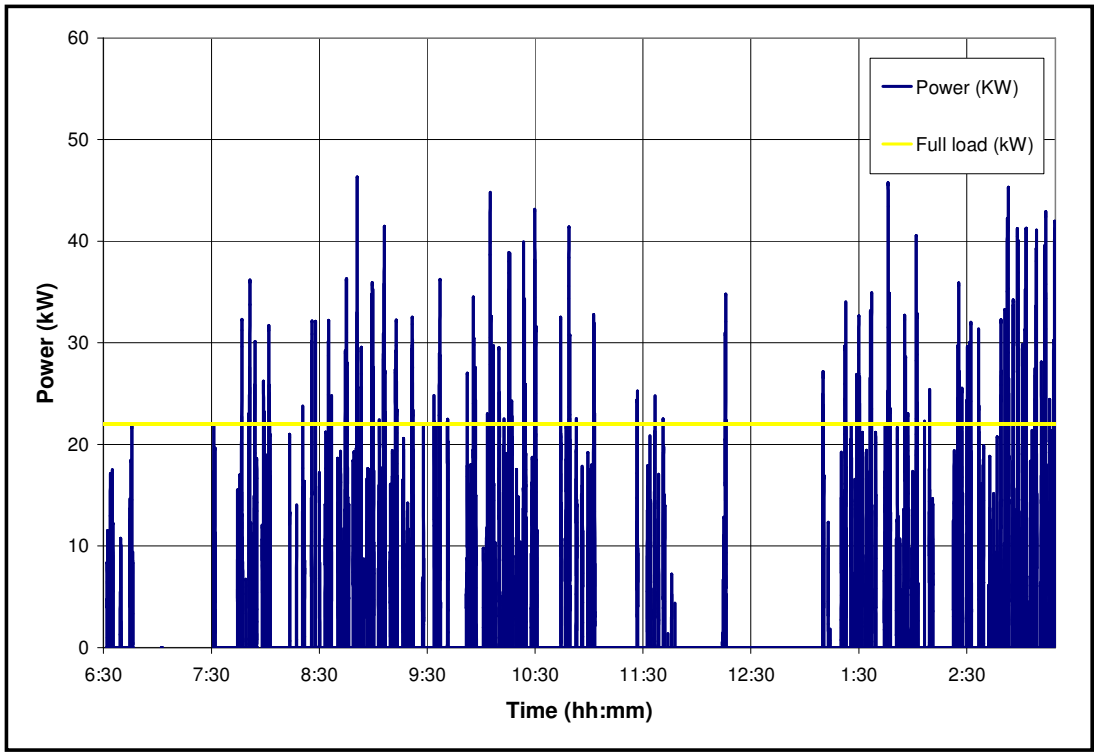

Figure P.1-5: Load power for a RH traction motor – 04 July 2005.

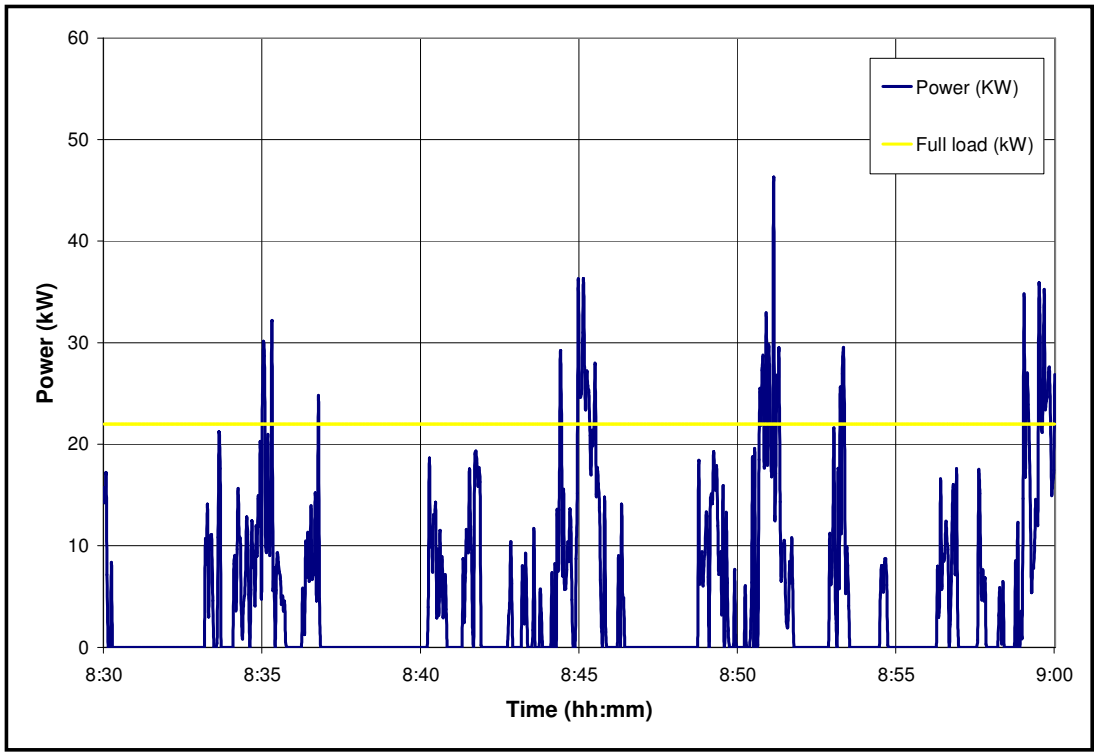

Figure P.1-6: Load power for a RH traction motor – 04 July 2005 (30 minute period).

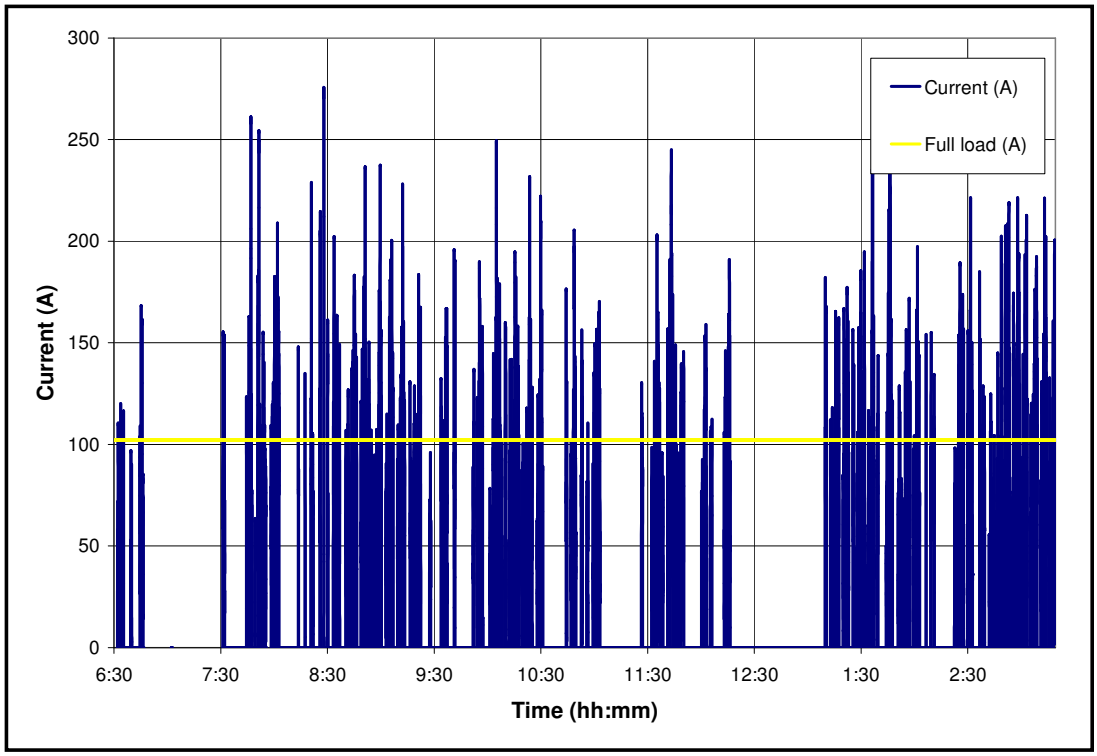

Figure P.1-7: Load current for a RH traction motor – 04 July 2005.

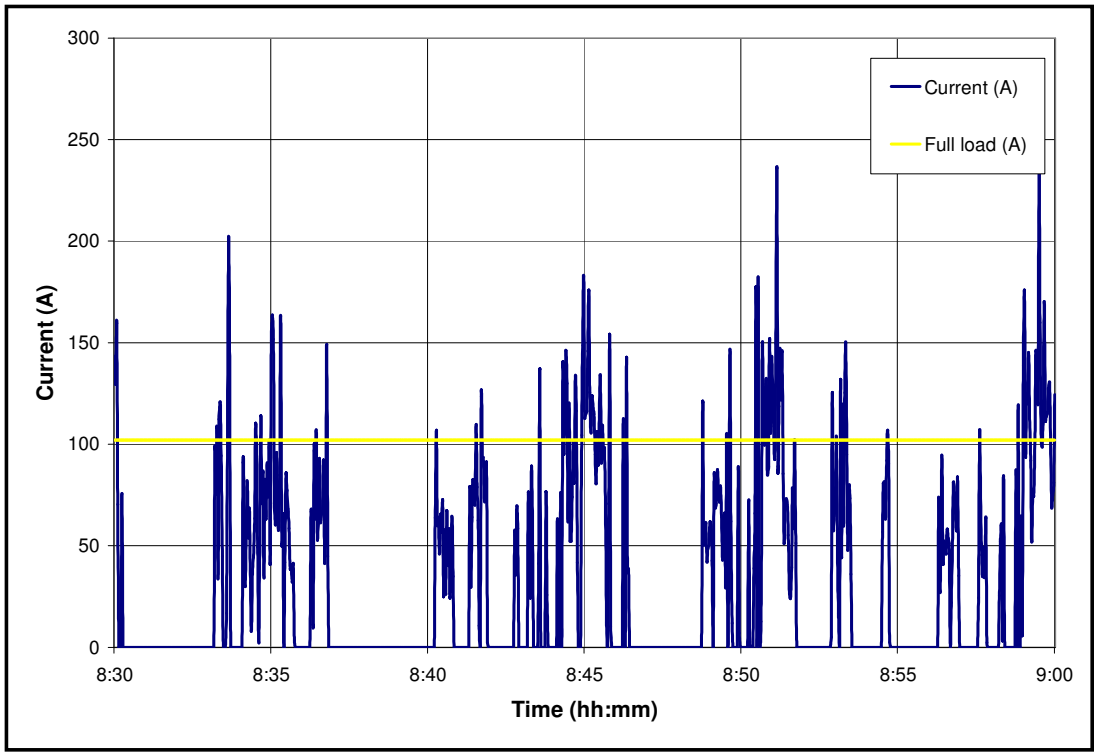

Figure P.1-8: Load current for a RH traction motor – 04 July 2005 (30 minute period).

P.1.1.2 Afternoon shifts

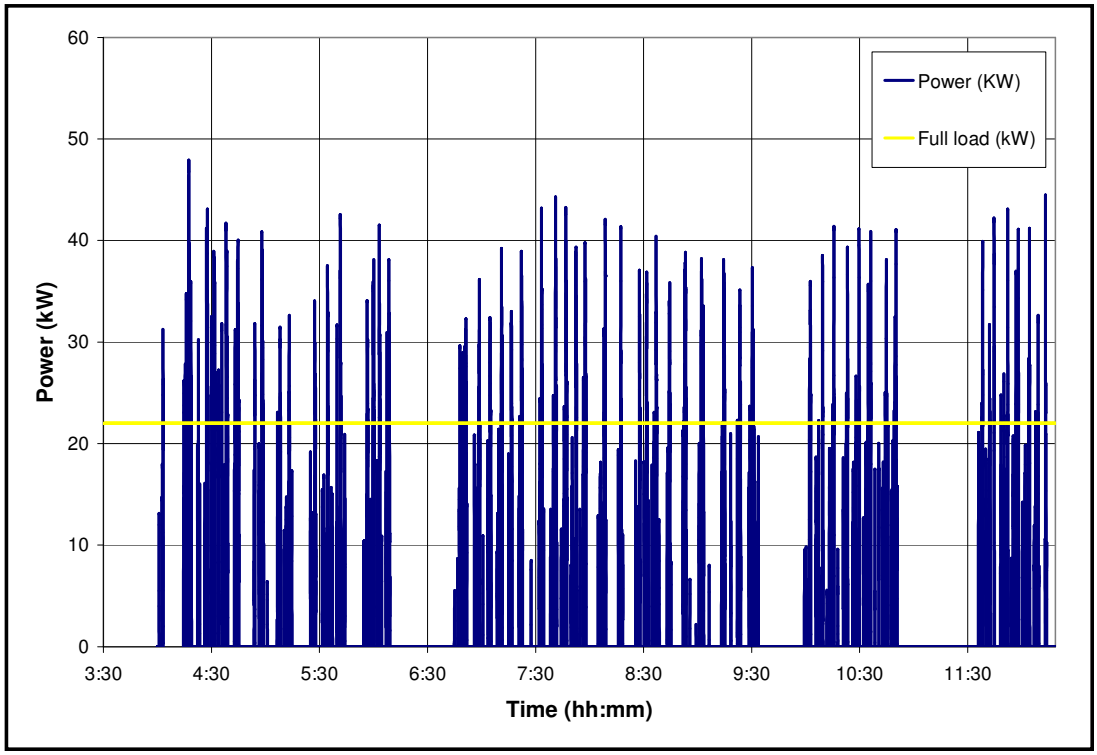

Figure P.1-9: Load power for a LH traction motor – 04 July 2005.

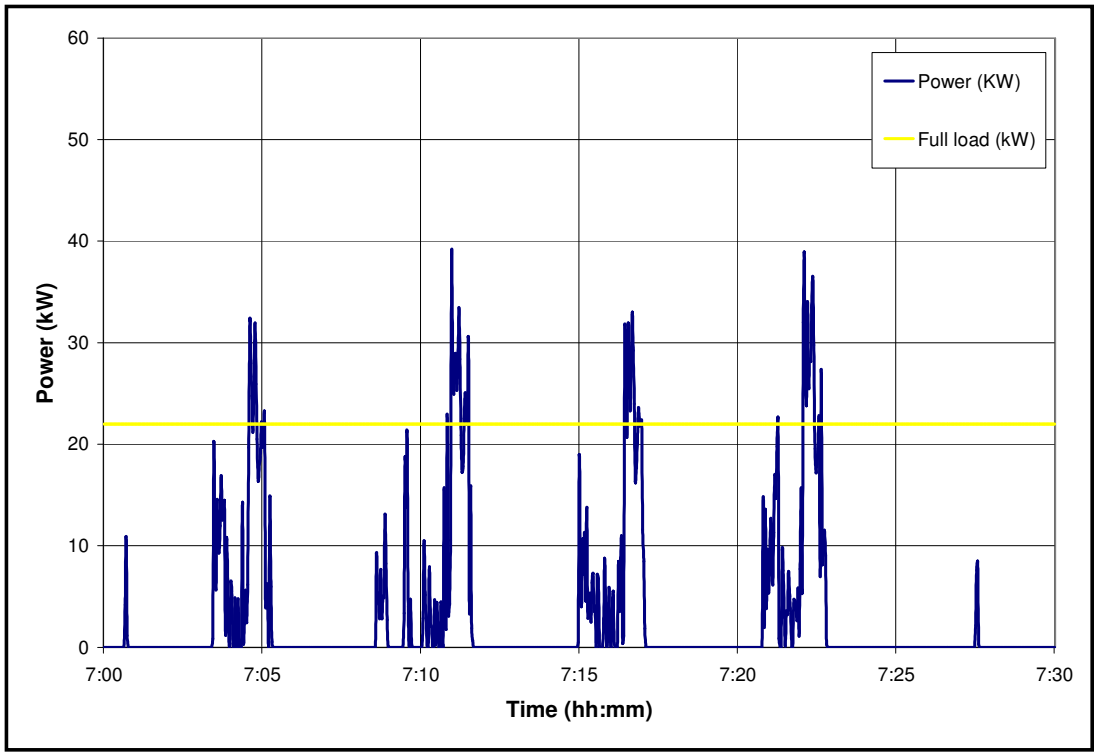

Figure P.1-10: Load power for a LH traction motor – 04 July 2005 (30 minute period).

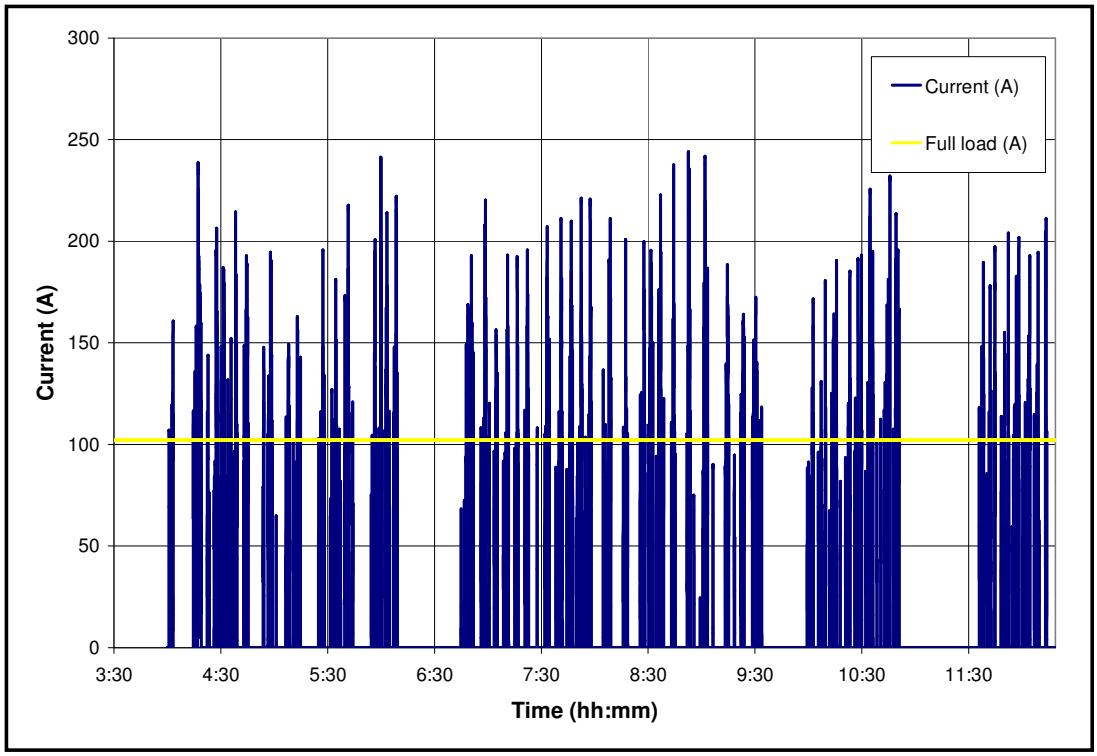

Figure P.1-11: Load current for a LH traction motor – 04 July 2005.

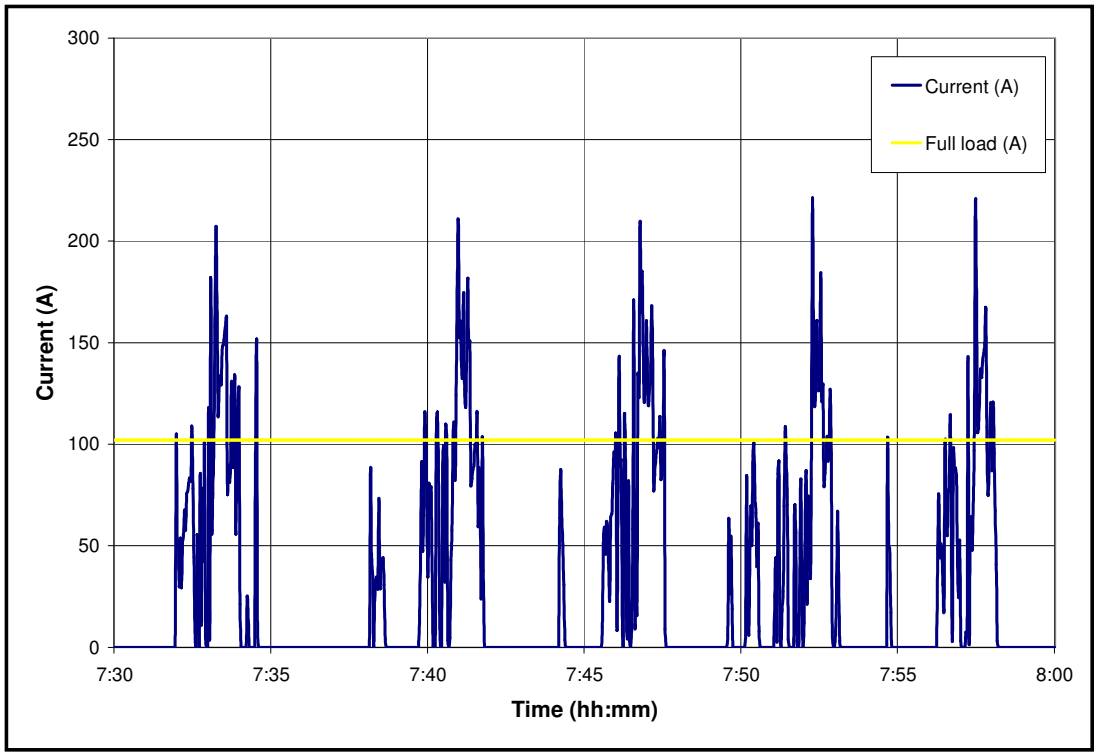

Figure P.1-12: Load current for a LH traction motor – 04 July 2005 (30 minute period).

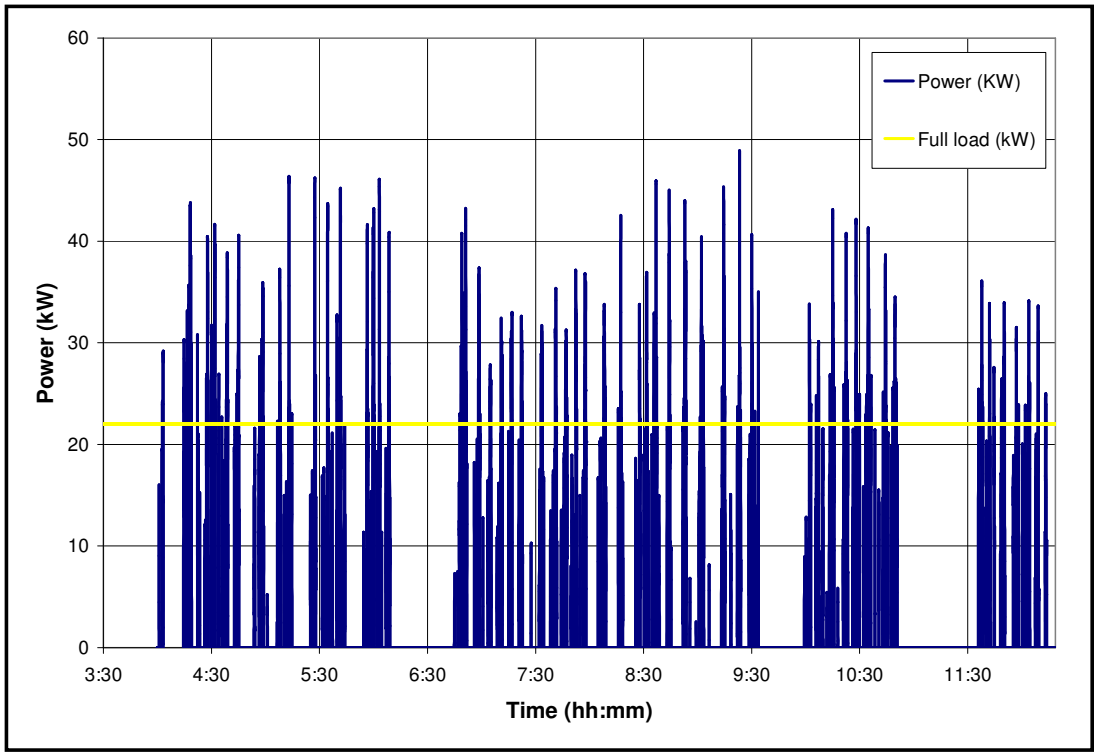

Figure P.1-13: Load power for a RH traction motor – 04 July 2005.

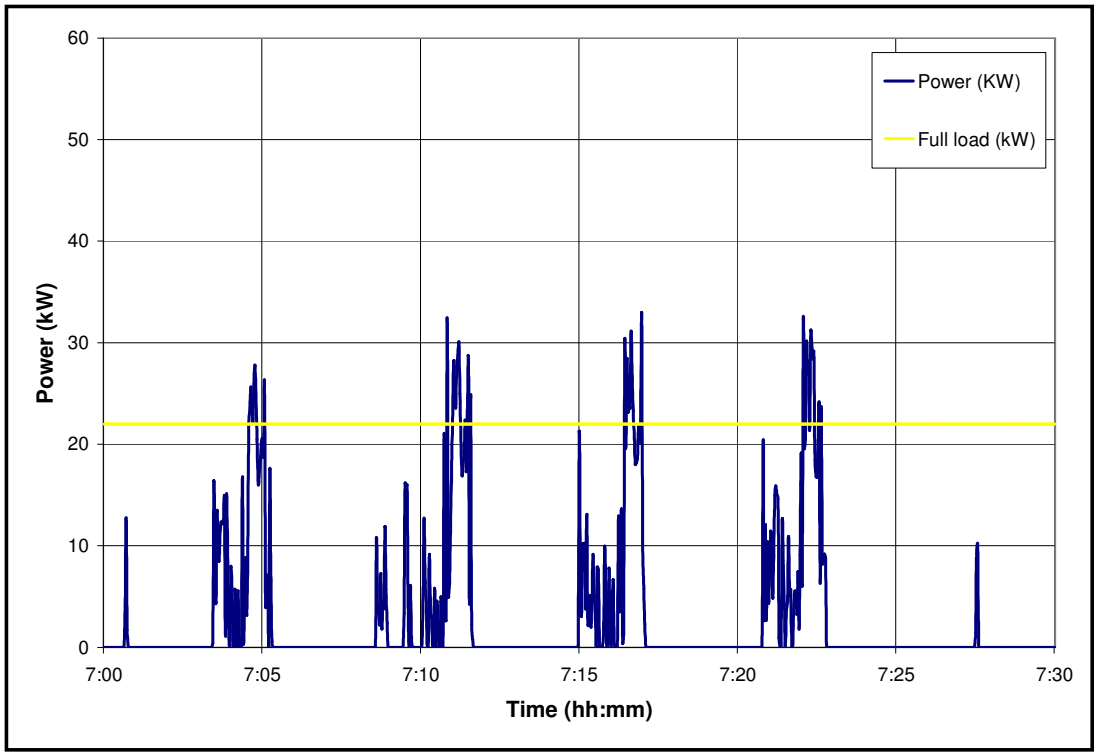

Figure P.1-14: Load power for a RH traction motor – 04 July 2005 (30 minute period).

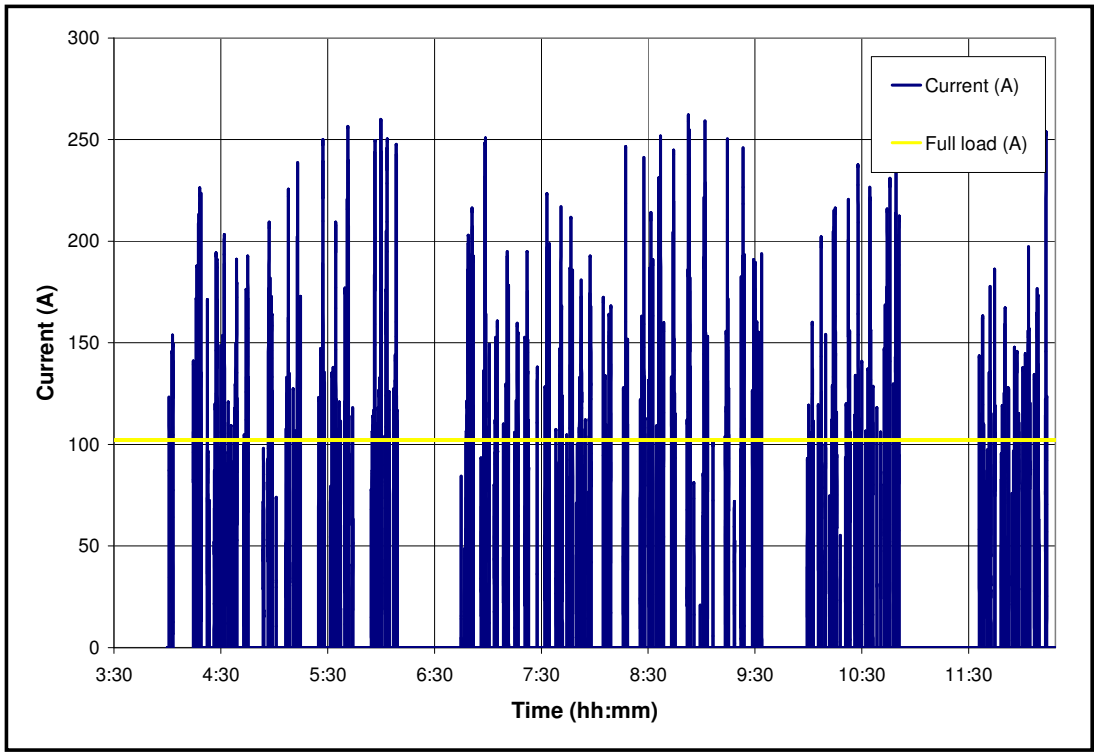

Figure P.1-15: Load current for a RH traction motor – 04 July 2005.

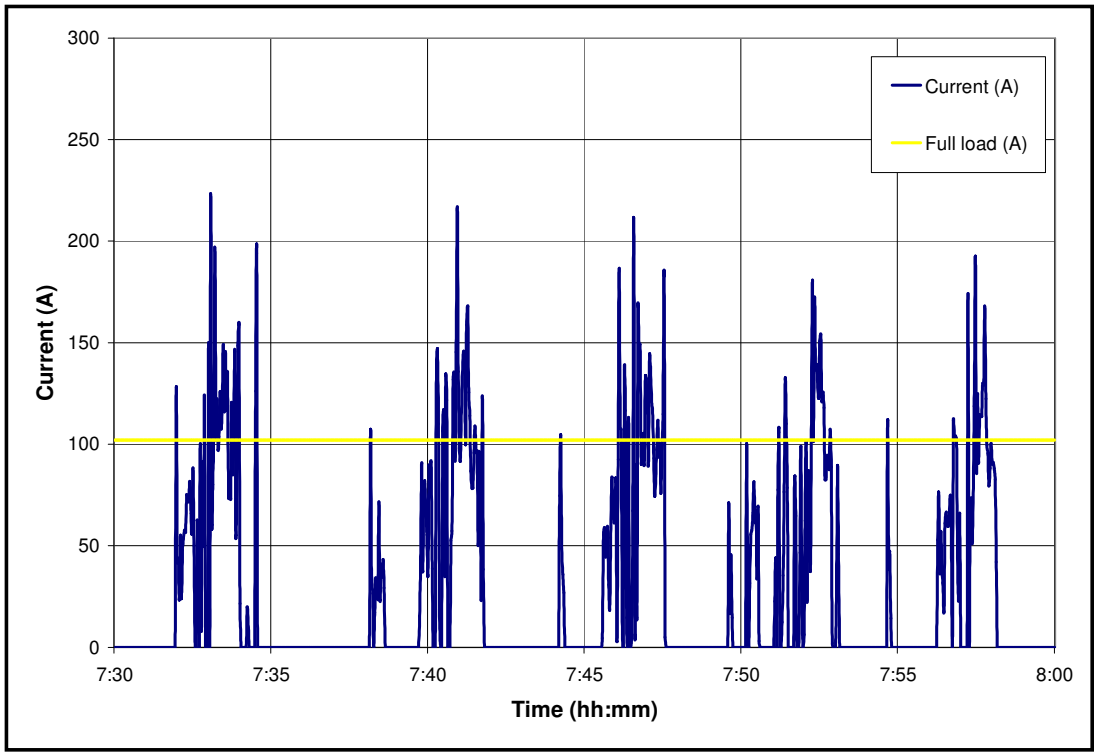

Figure P.1-16: Load current for a RH traction motor – 04 July 2005 (30 minute period).

P.1.2 SECTION 51

P.1.2.1 Morning shifts

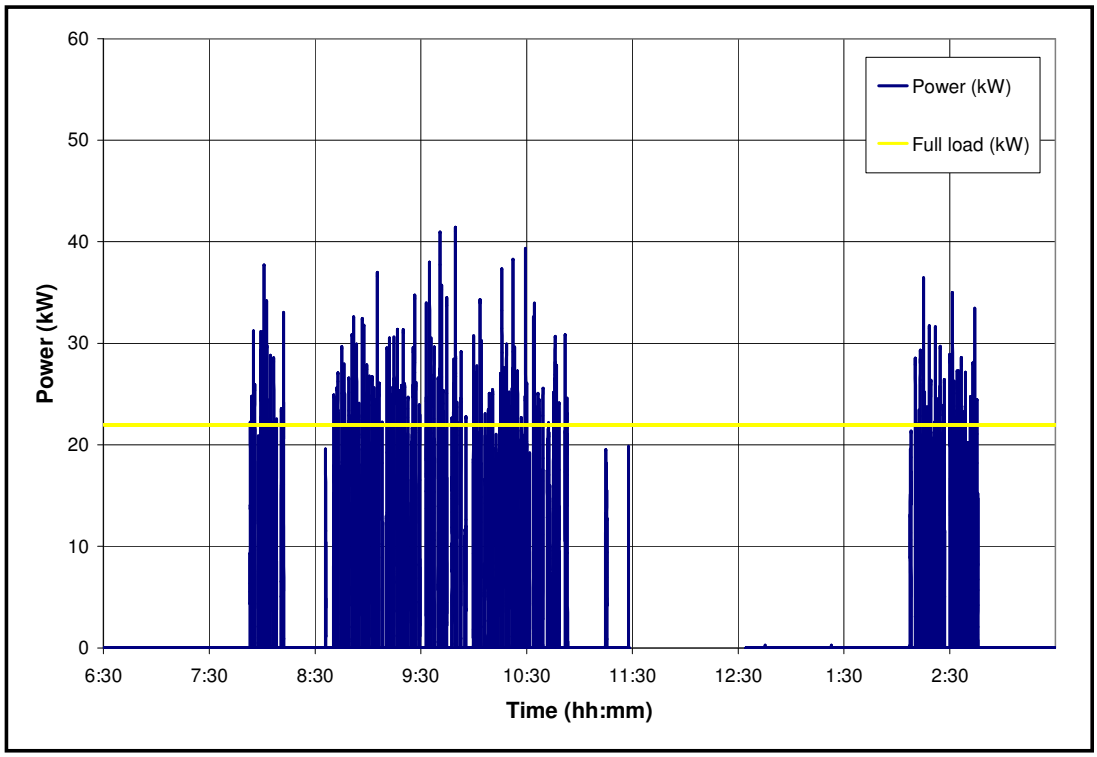

Figure P.1-17: Load power for a LH traction motor – 20 June 2005

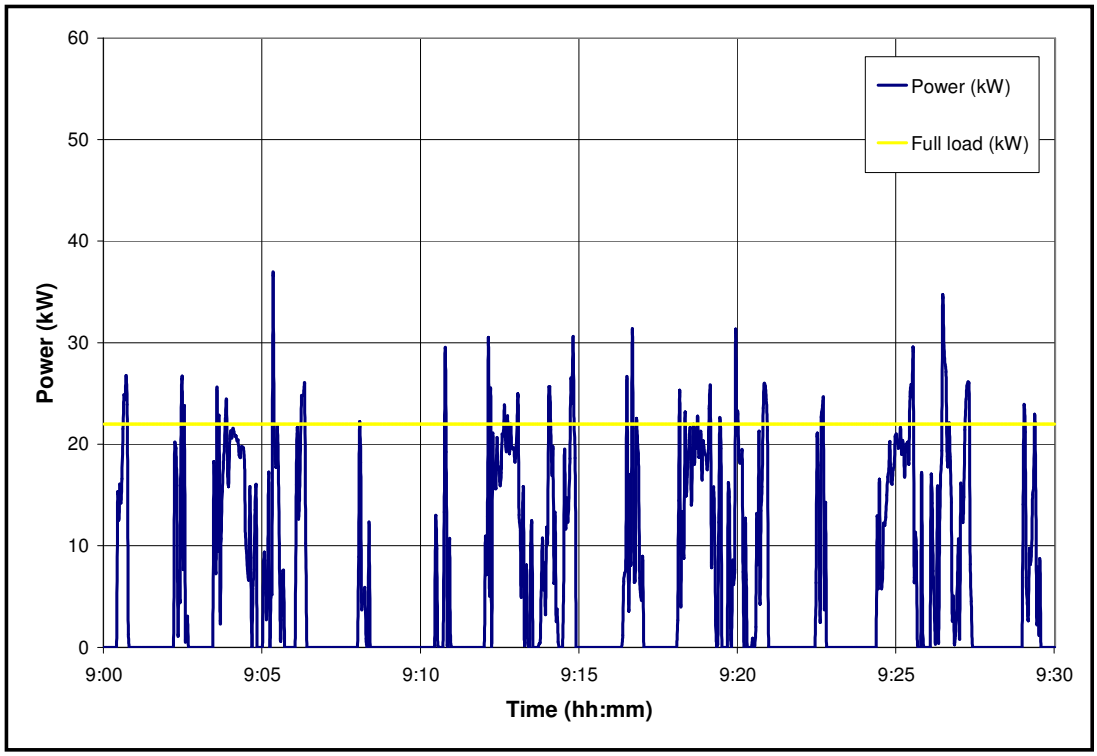

Figure P.1-18: Load power for a LH traction motor – 20 June 2005 (30 minute period).

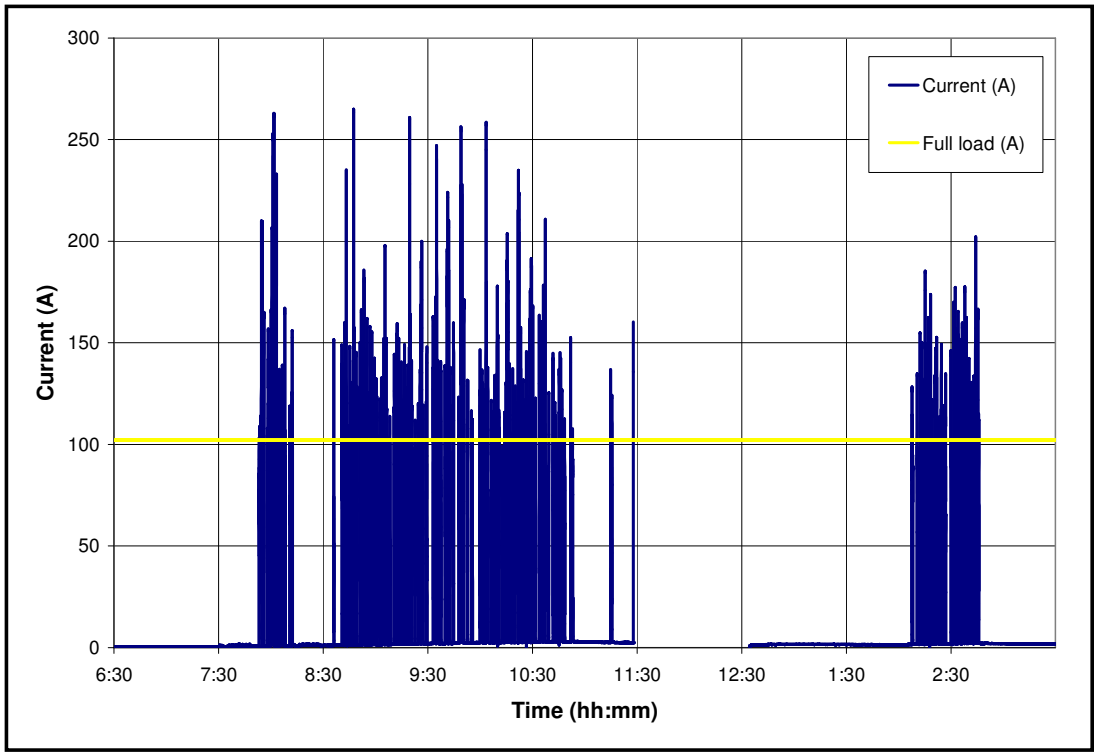

Figure P.1-19: Load current for a LH traction motor – 20 June 2005

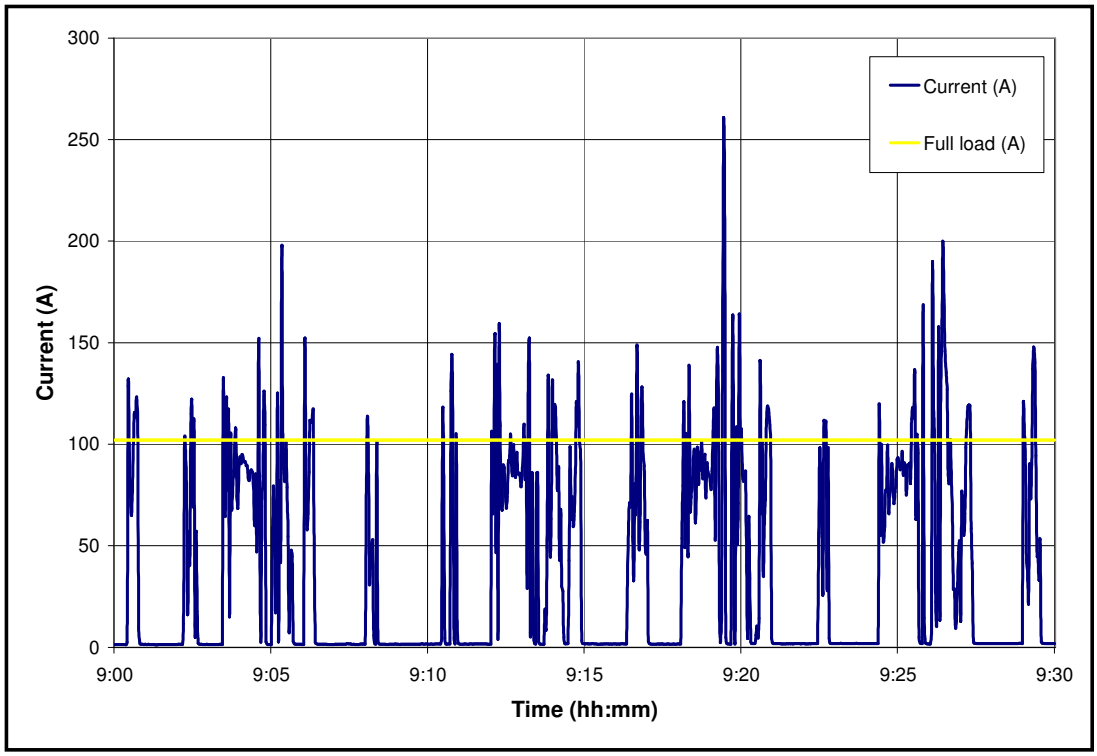

Figure P.1-20: Load current for a LH traction motor – 20 June 2005 (30 minute period).

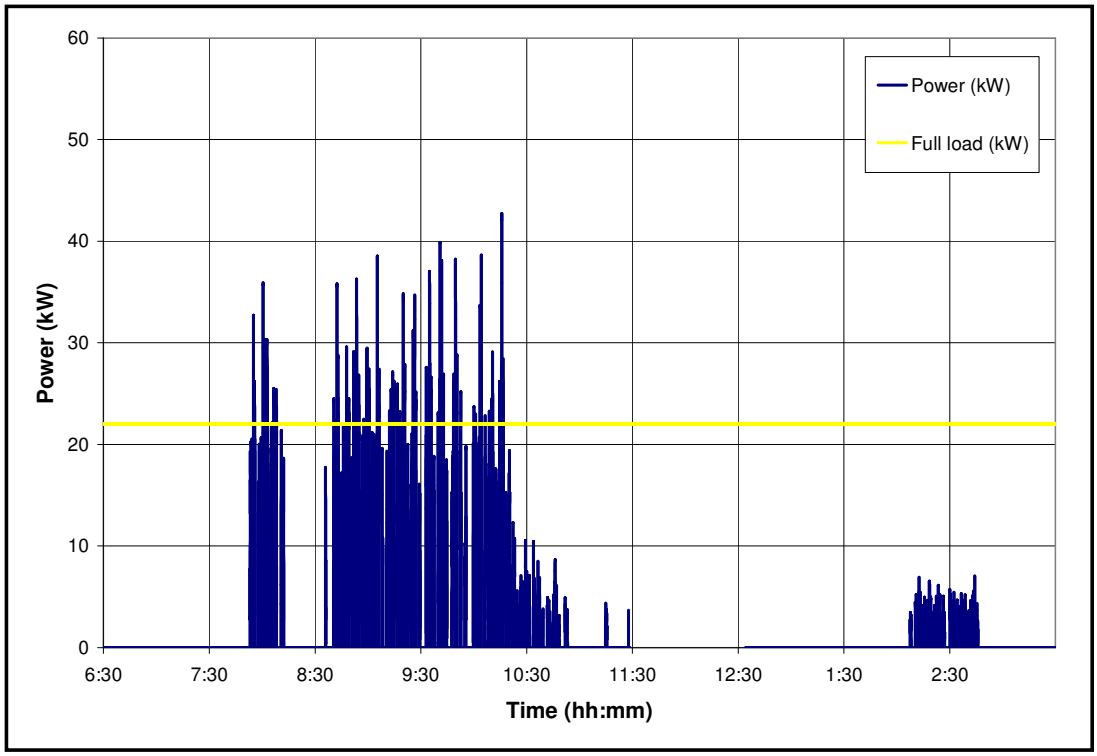

Figure P.1-21: Load power for a RH traction motor – 20 June 2005.

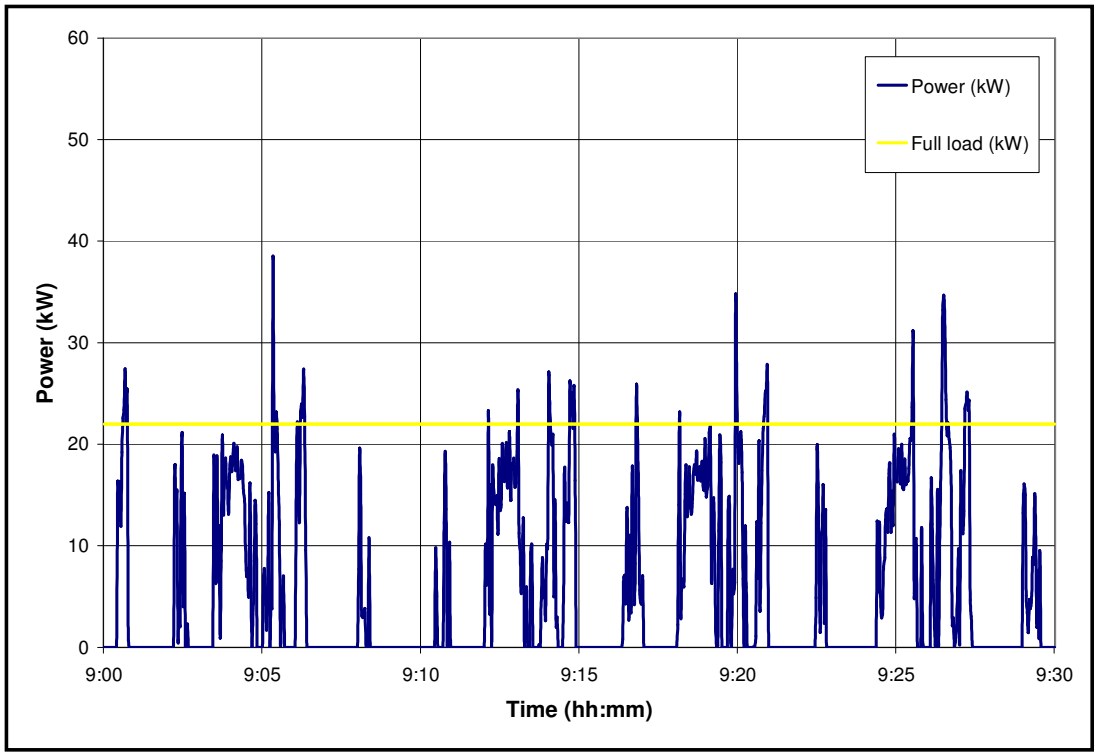

Figure P.1-22: Load power for a RH traction motor – 20 June 2005 (30 minute period).

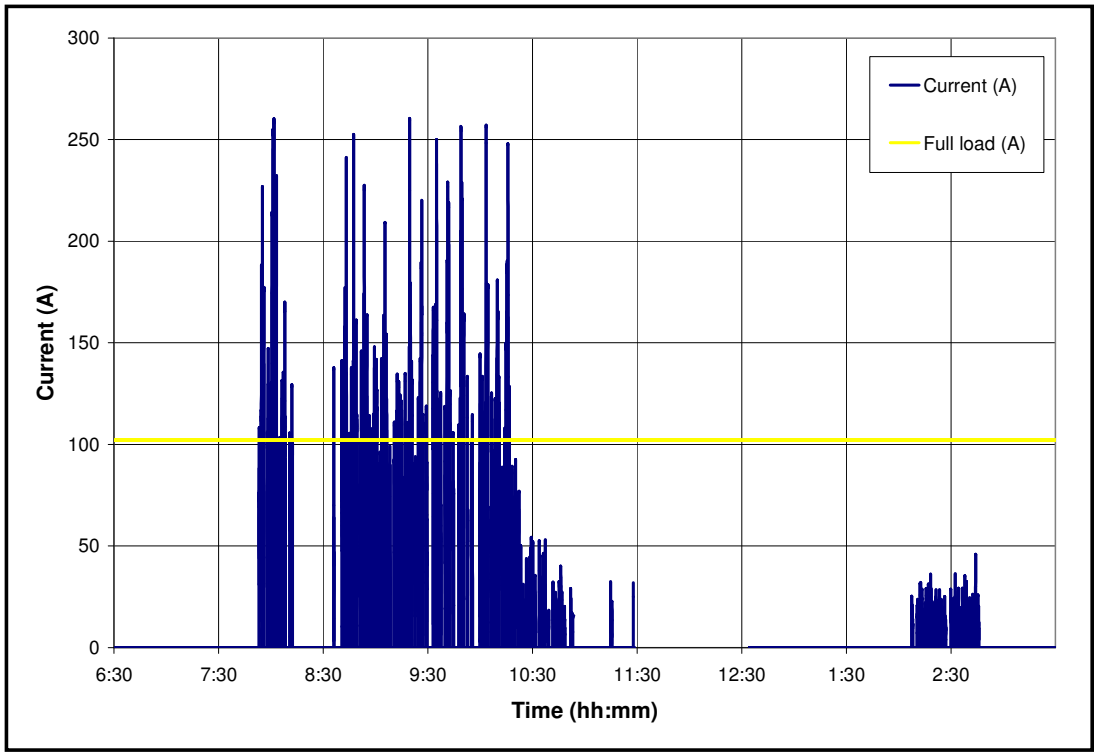

Figure P.1-23: Load current for a RH traction motor – 20 June 2005.

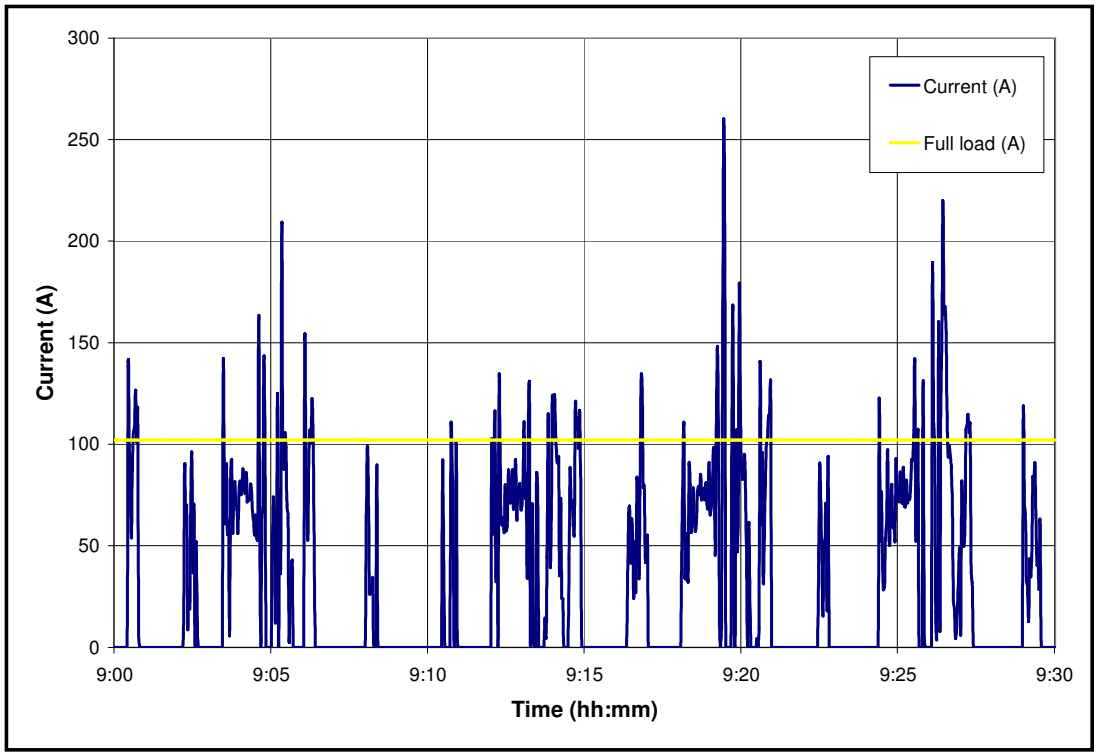

Figure P.1-24: Load current for a RH traction motor – 20 June 2005 (30 minute period).

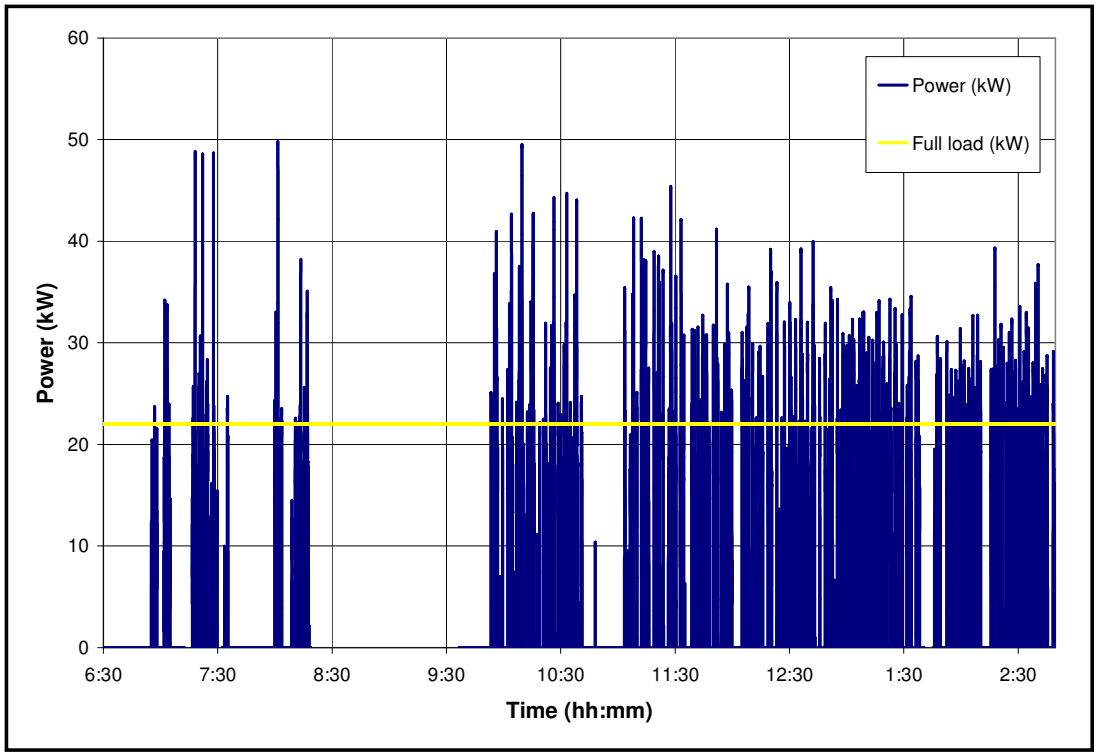

Figure P.1-25: Load power for a LH traction motor – 21 June 2005.

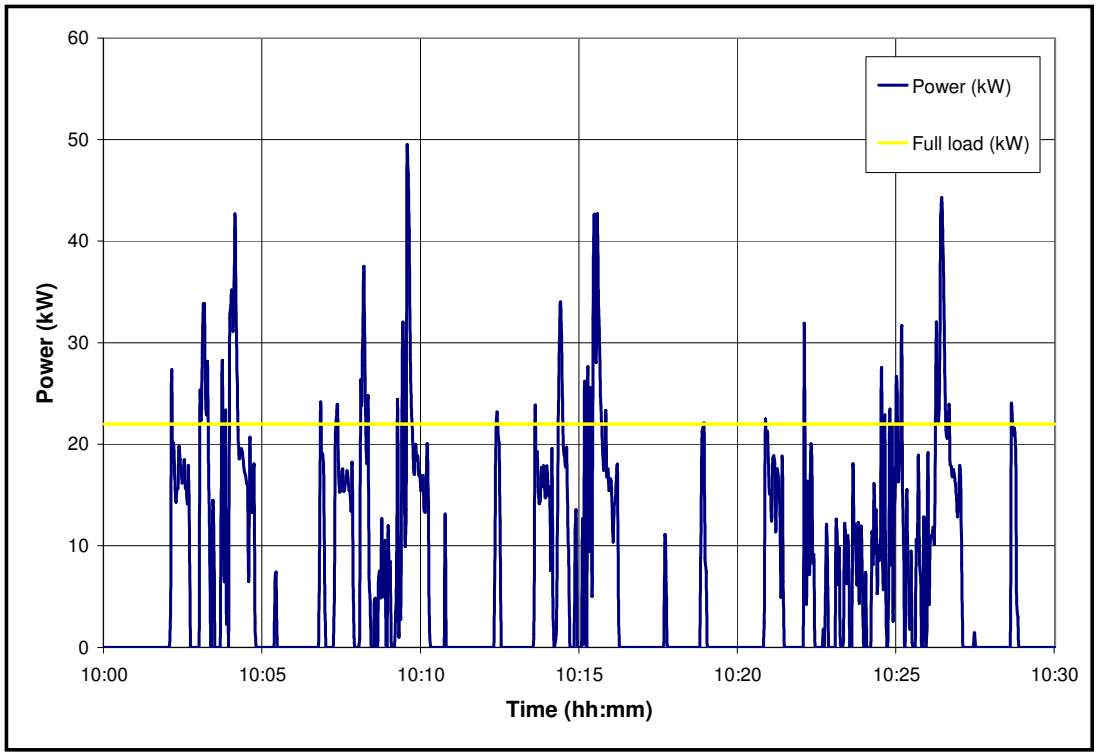

Figure P.1-26: Load power for a LH traction motor – 21 June 2005 (30 minute period).

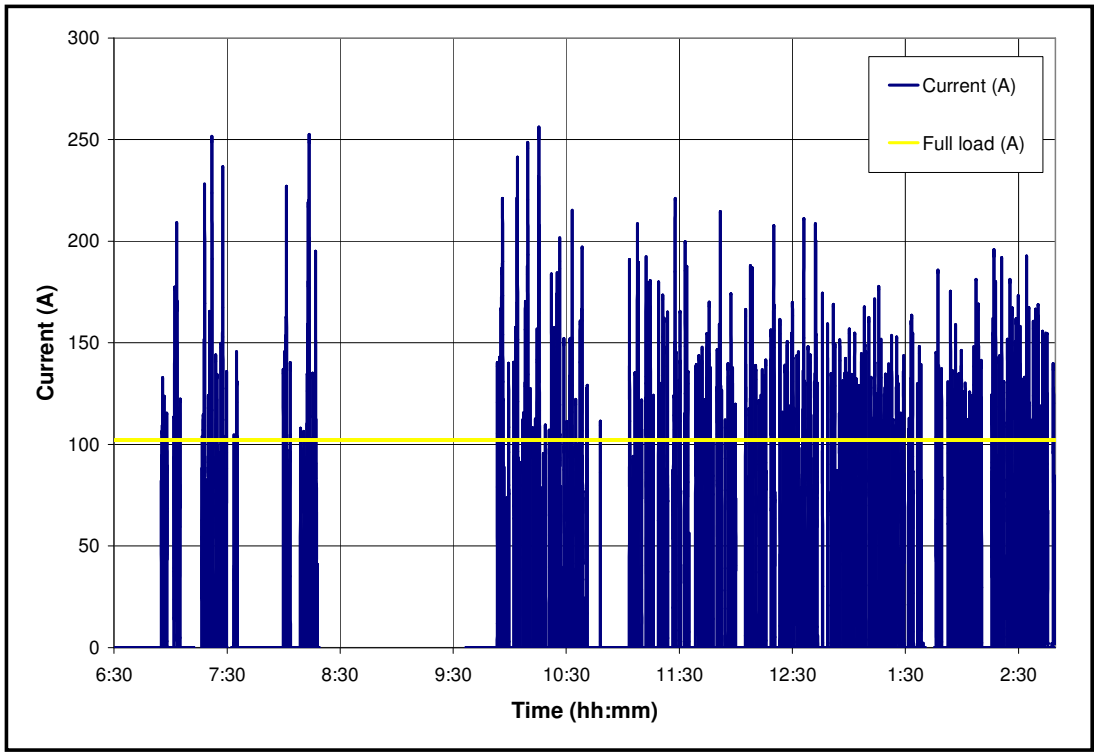

Figure P.1-27: Load current for a LH traction motor – 21 June 2005.

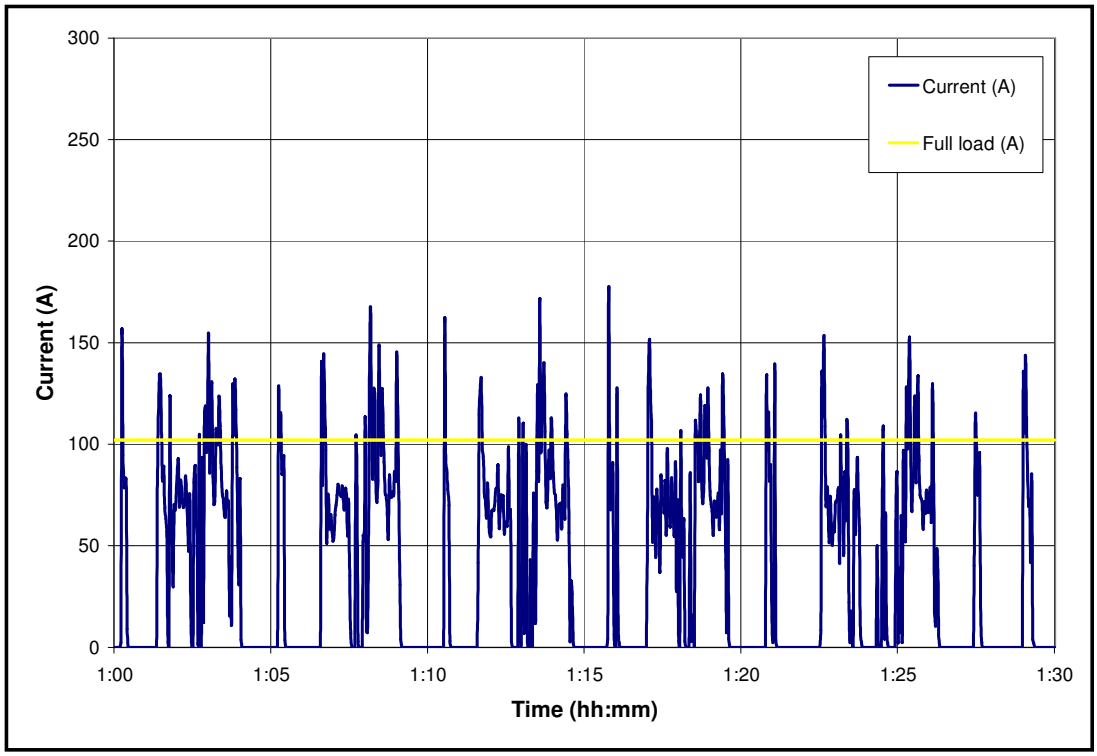

Figure P.1-28: Load current for a LH traction motor – 21 June 2005 (30 minute period).

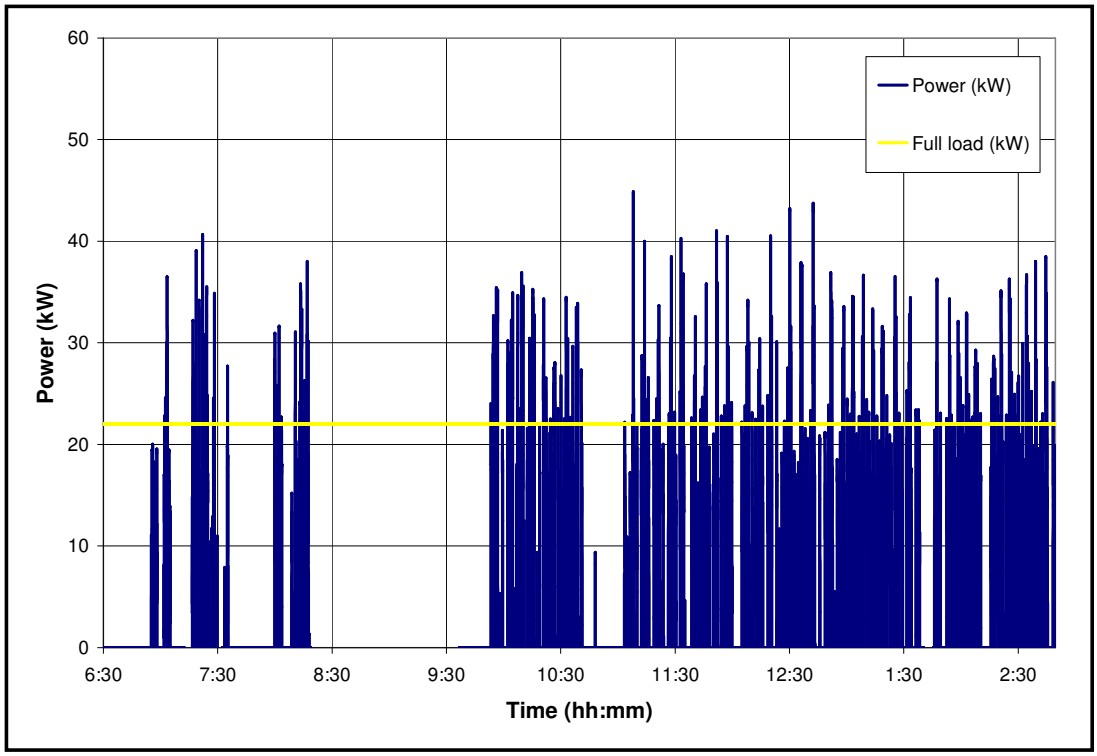

Figure P.1-29: Load power for a RH traction motor – 21 June 2005.

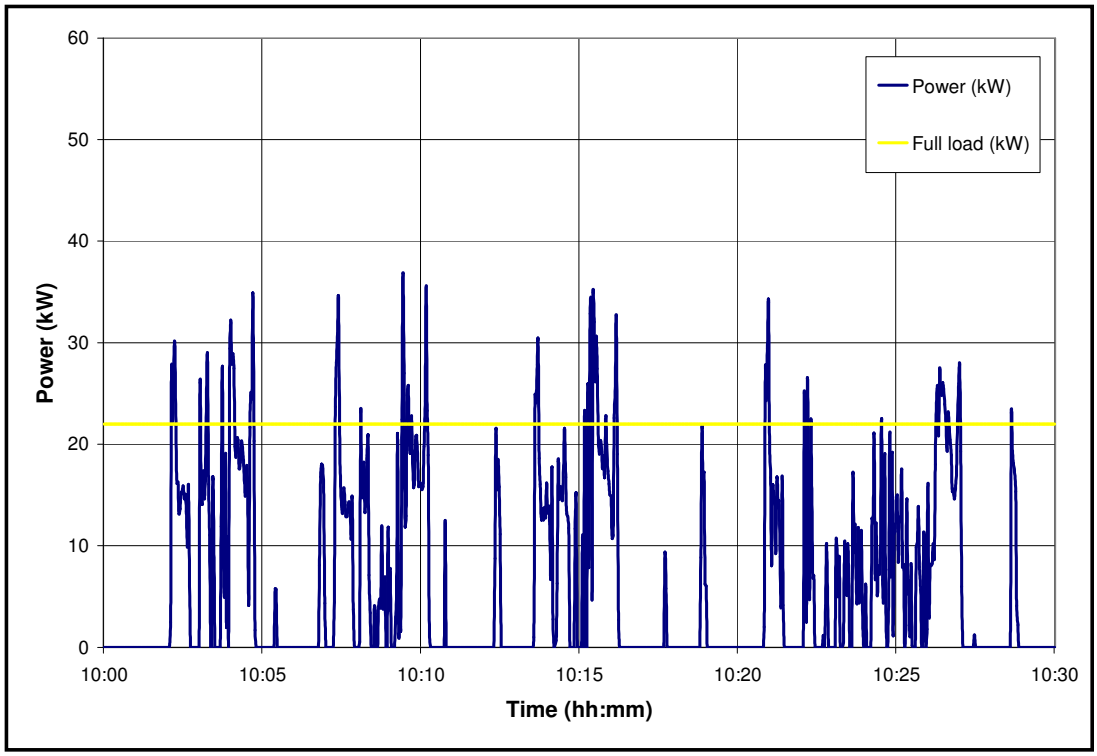

Figure P.1-30: Load power for a RH traction motor – 21 June 2005 (30 minute period).

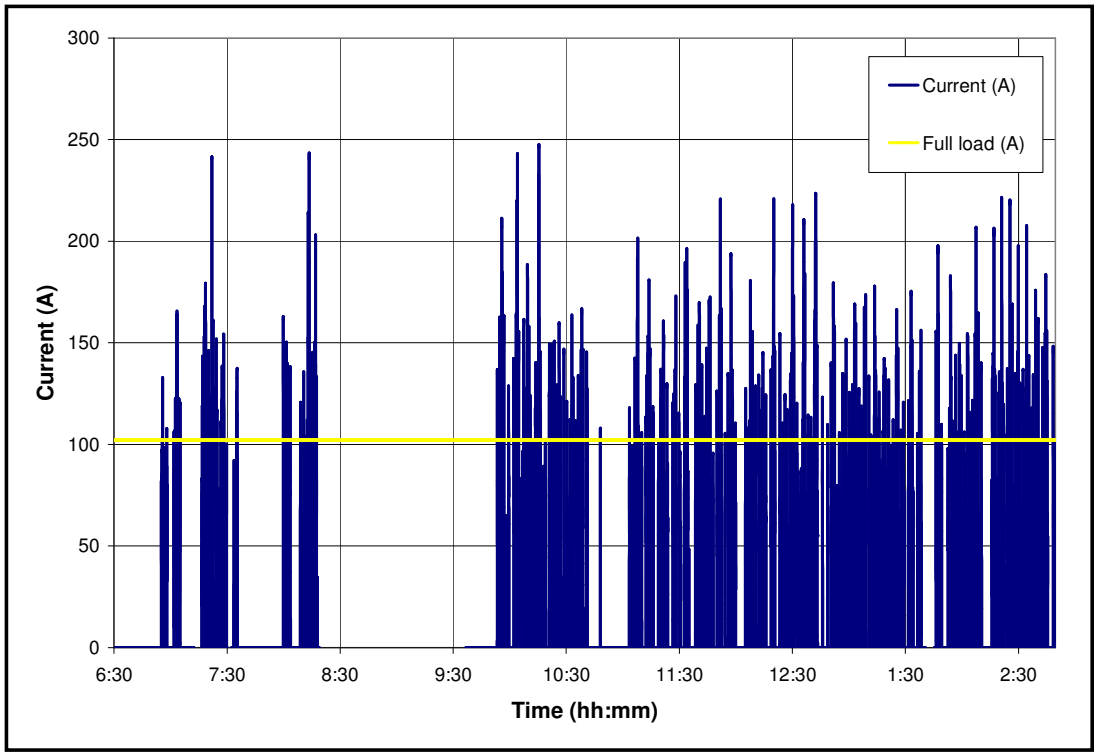

Figure P.1-31: Load current for a RH traction motor – 21 June 2005.

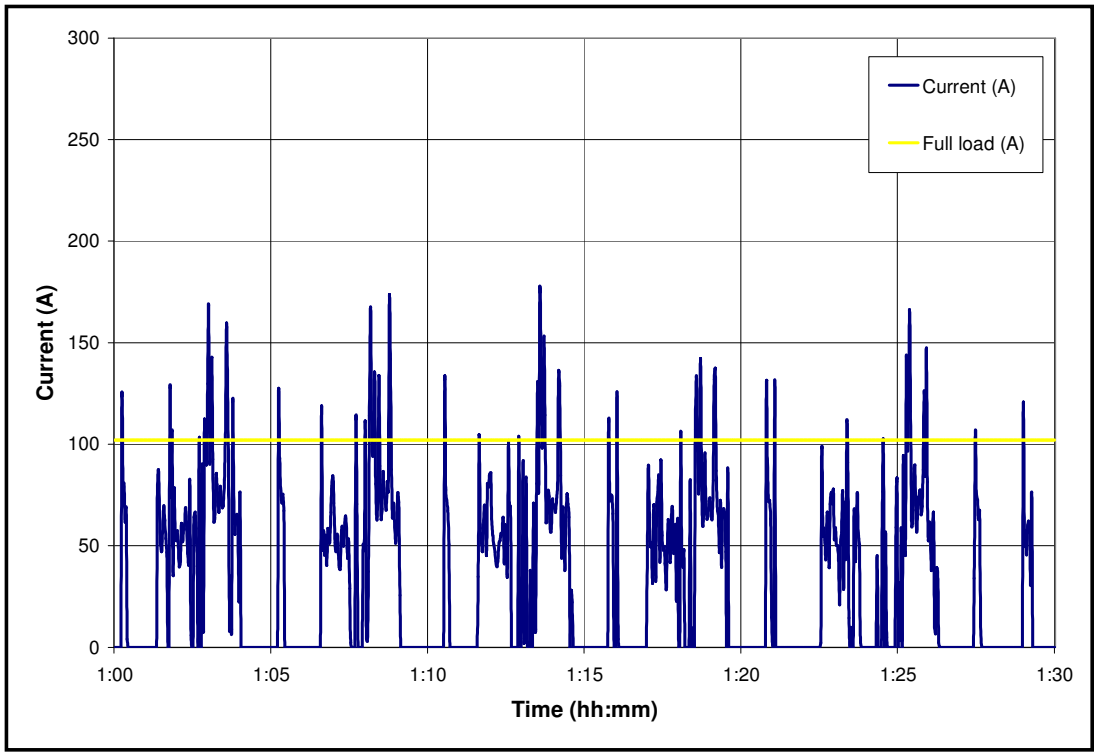

Figure P.1-32: Load current for a RH traction motor – 21 June 2005 (30 minute period).

P.1.2.2 Afternoon shifts

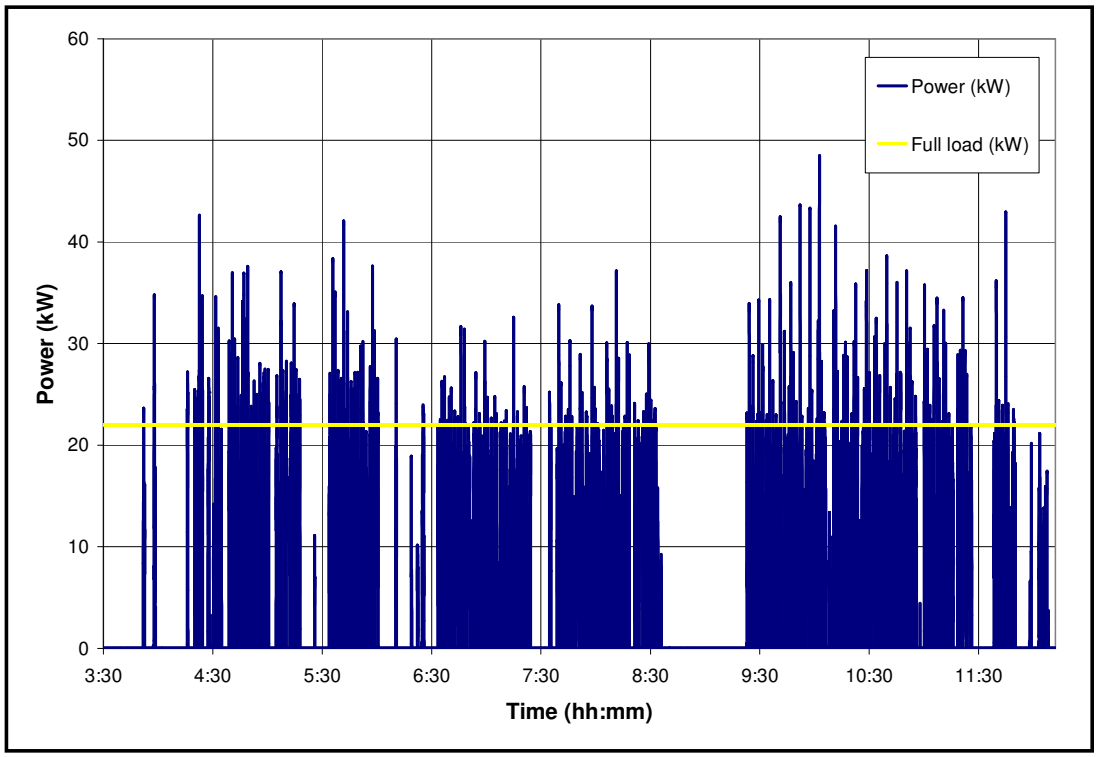

Figure P.1-33: Load power for a LH traction motor – 20 June 2005.

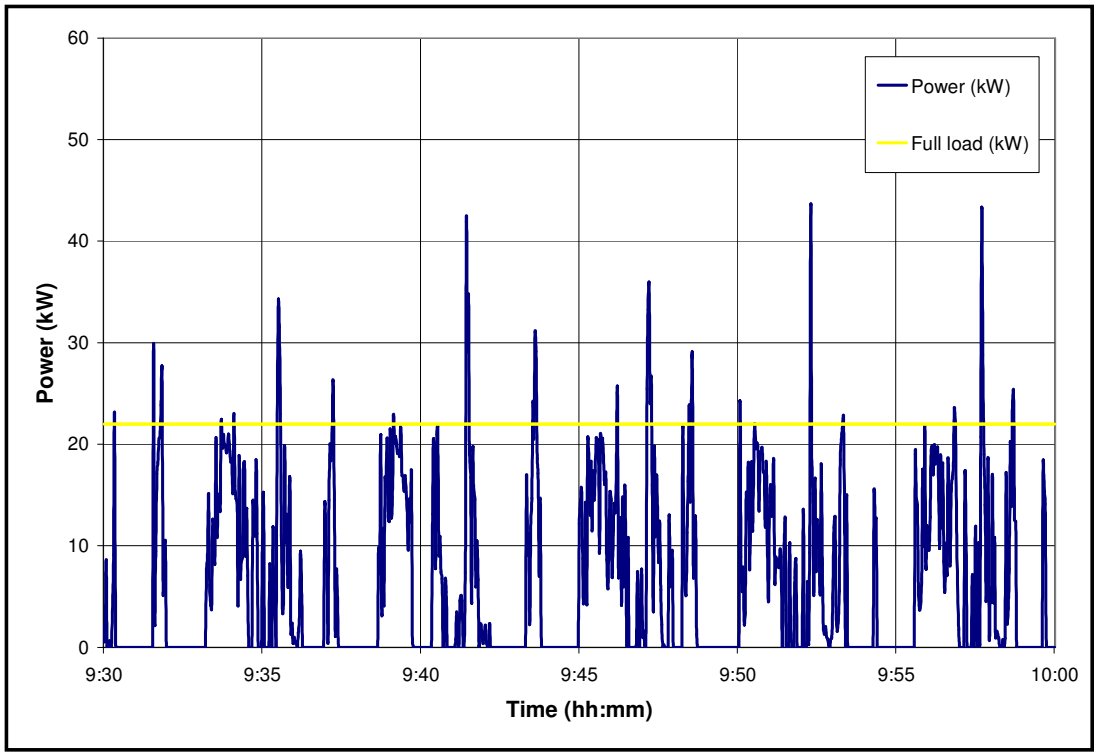

Figure P.1-34: Load power for a LH traction motor – 20 June 2005 (30 minute period).

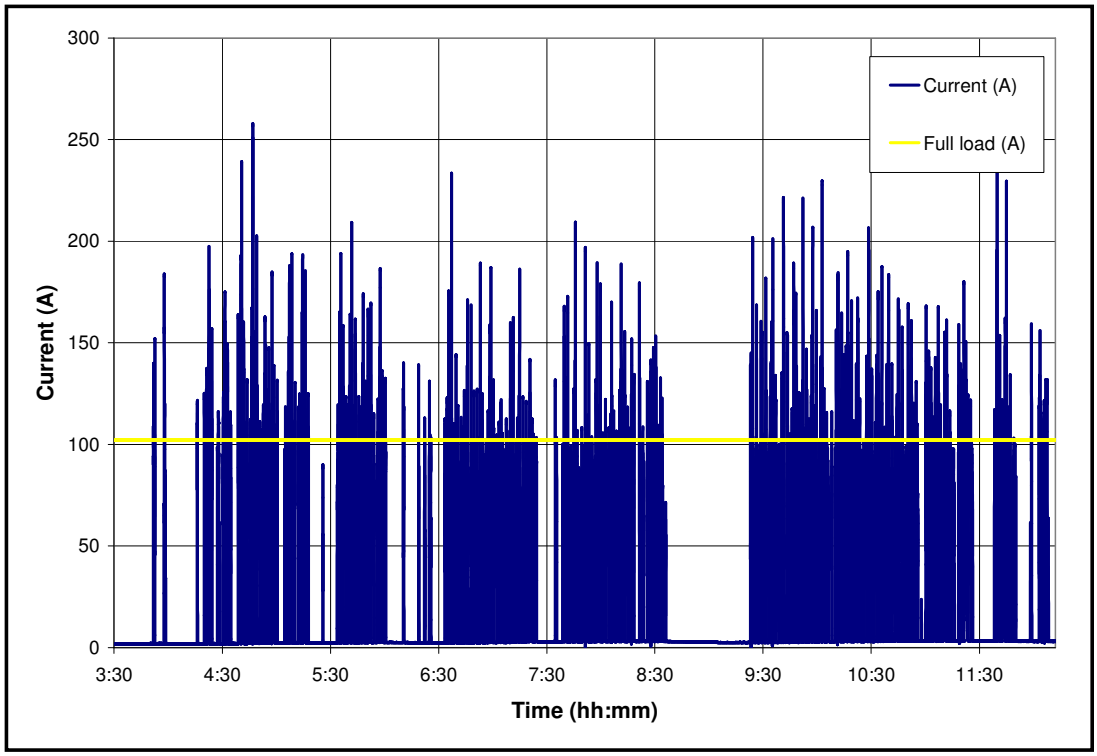

Figure P.1-35: Load current for a LH traction motor – 20 June 2005.

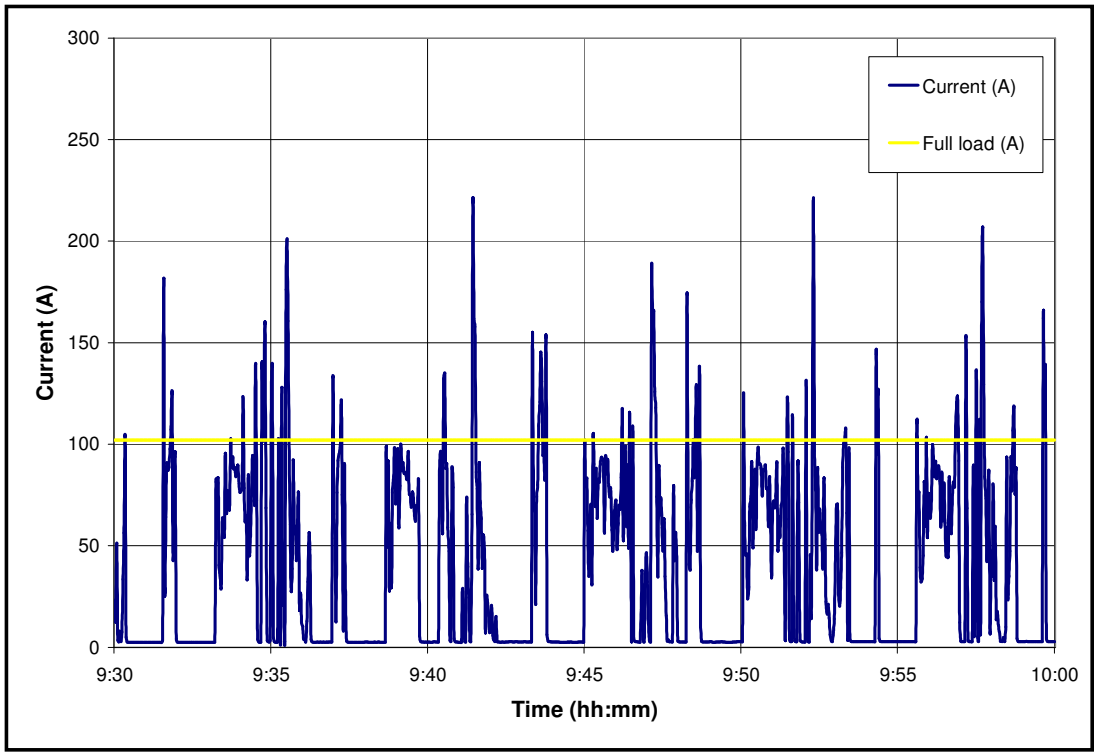

Figure P.1-36: Load current for a LH traction motor – 20 June 2005 (30 minute period).

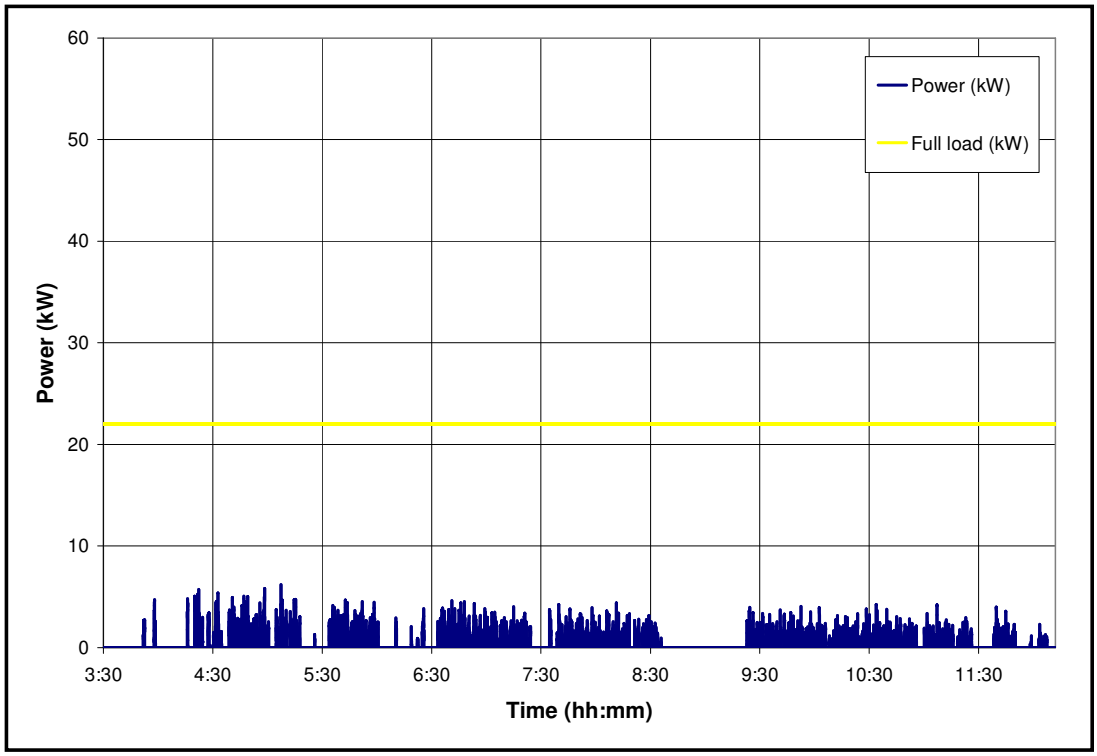

Figure P.1-37: Load power for a RH traction motor – 20 June 2005.

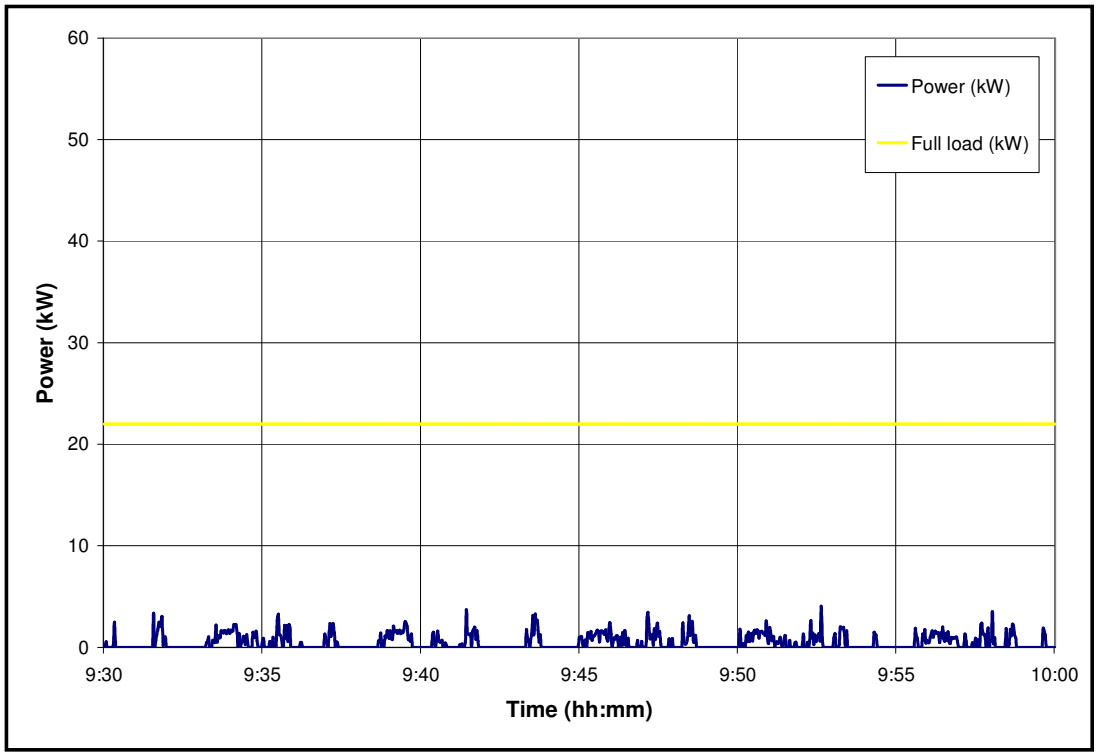

Figure P.1-38: Load power for a RH traction motor – 20 June 2005 (30 minute period).

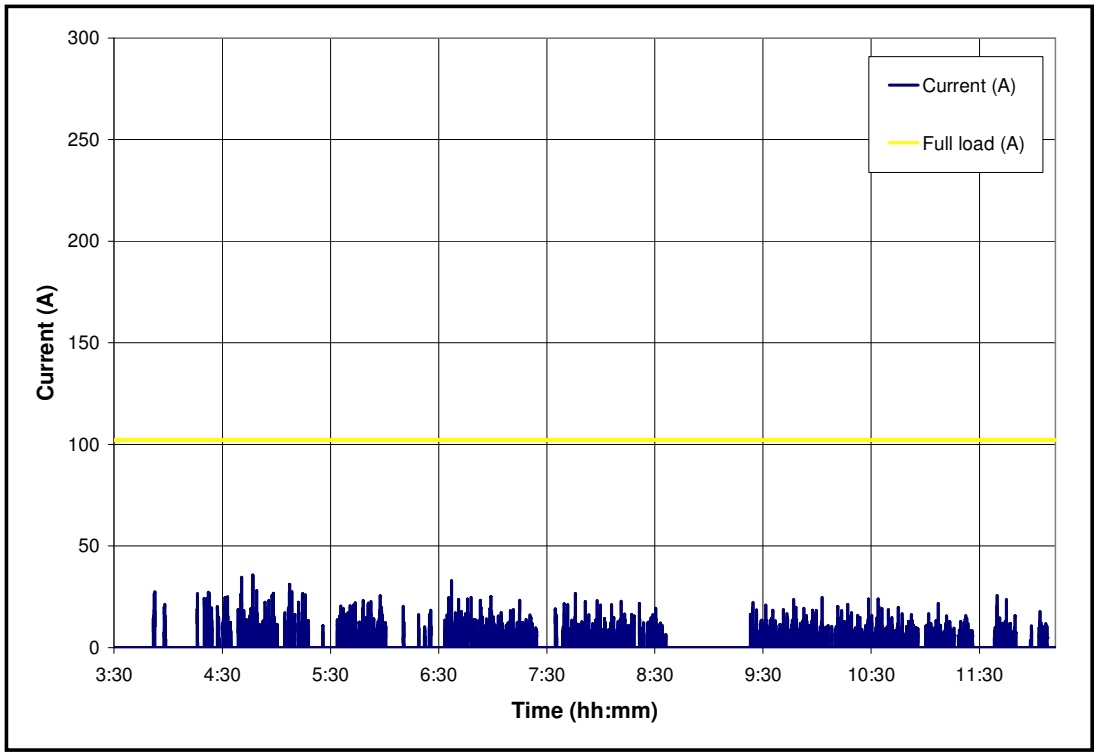

Figure P.1-39: Load current for a RH traction motor – 20 June 2005.

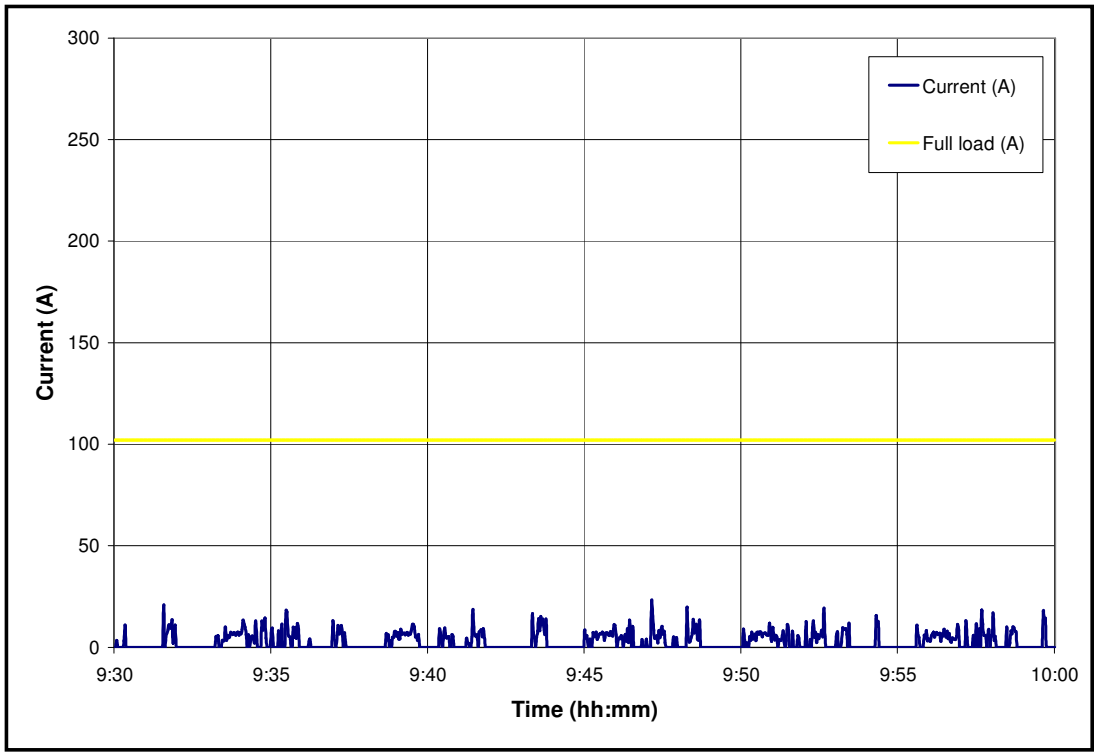

Figure P.1-40: Load current for a RH traction motor – 20 June 2005 (30 minute period).

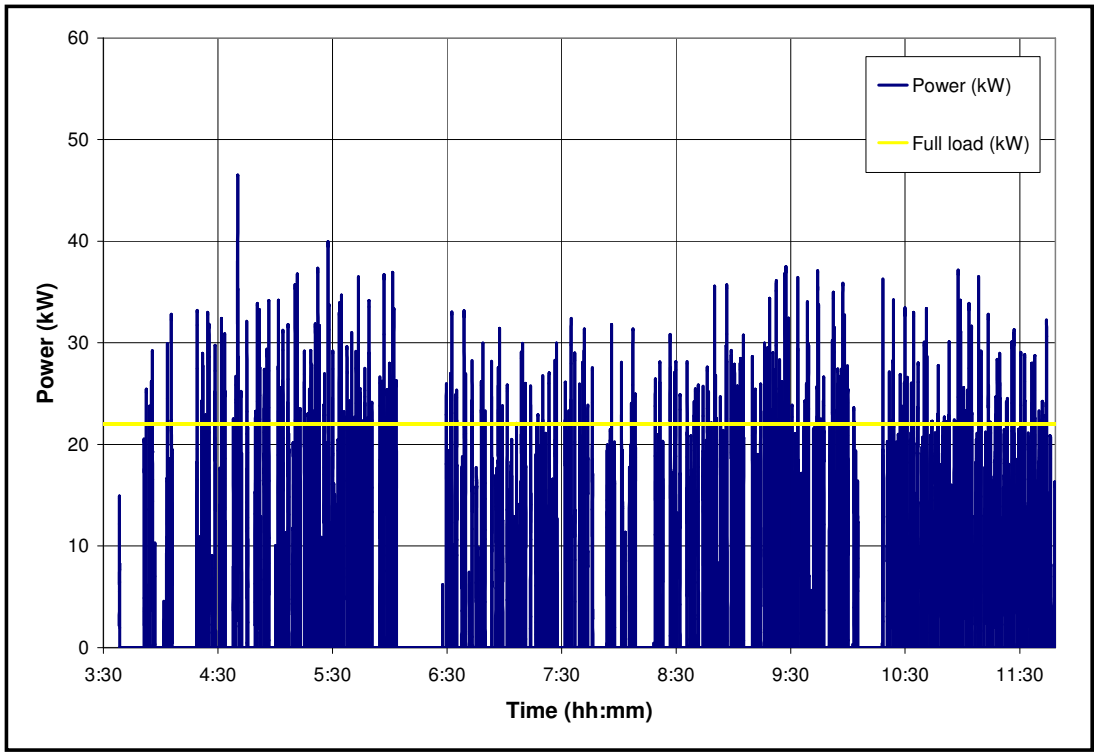

Figure P.1-41: Load power for a LH traction motor – 21 June 2005.

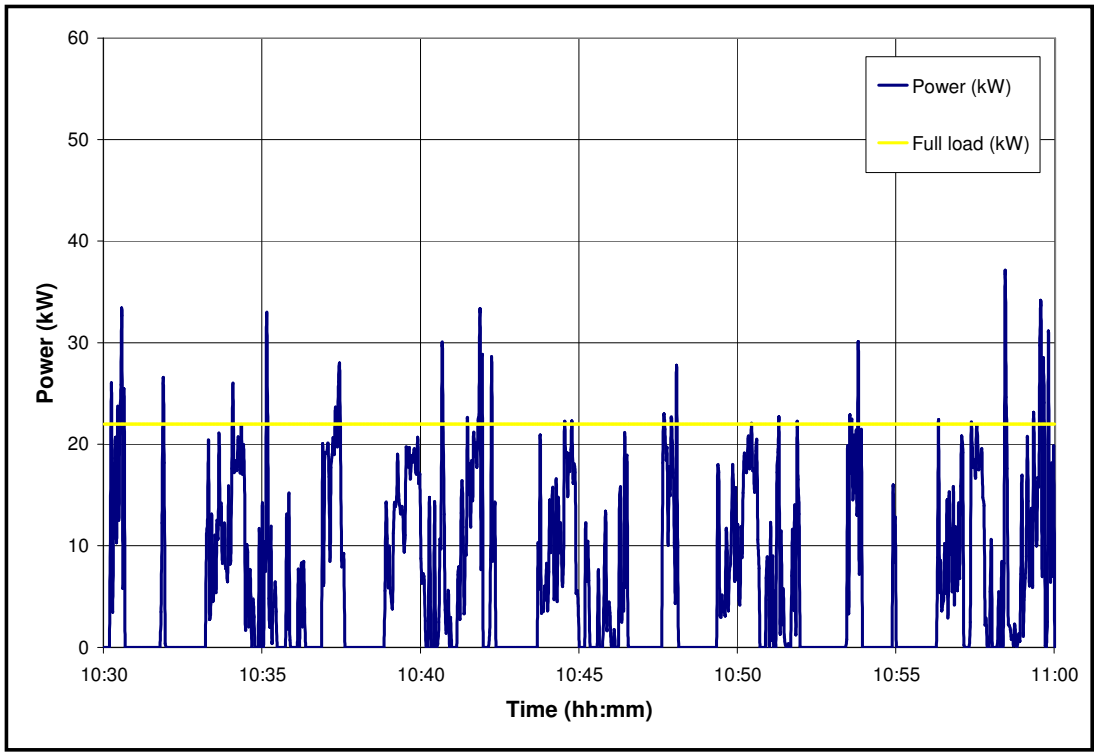

Figure P.1-42: Load power for a LH traction motor – 21 June 2005 (30 minute period).

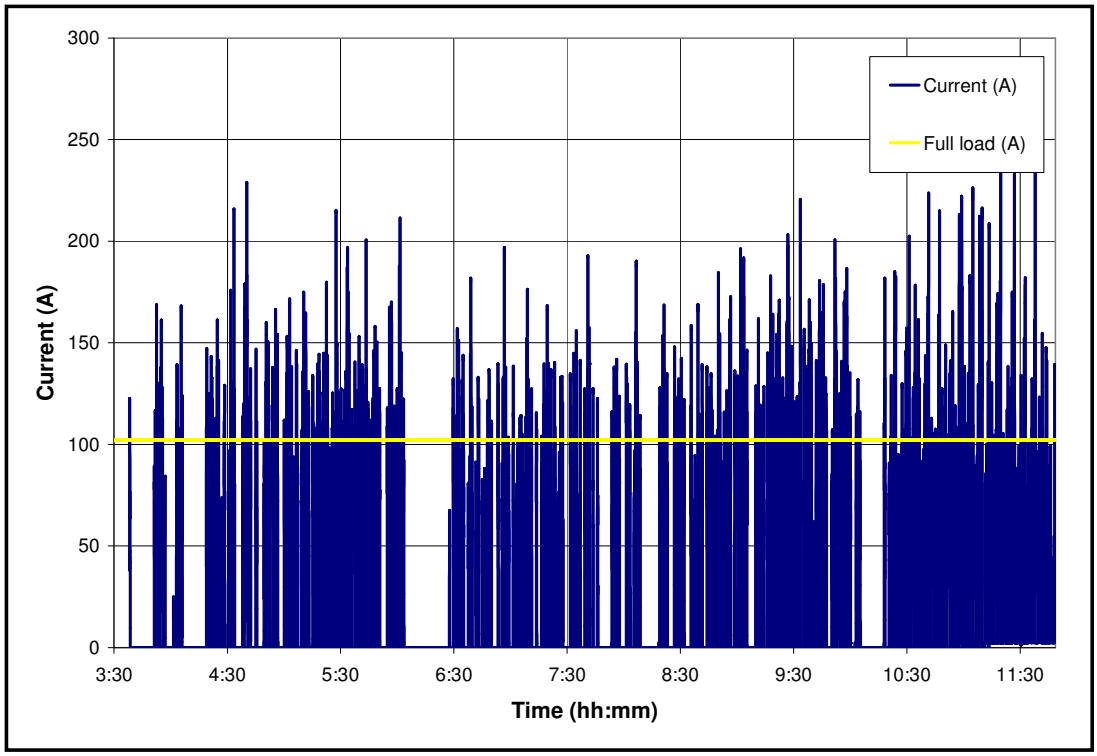

Figure P.1-43: Load current for a LH traction motor – 21 June 2005.

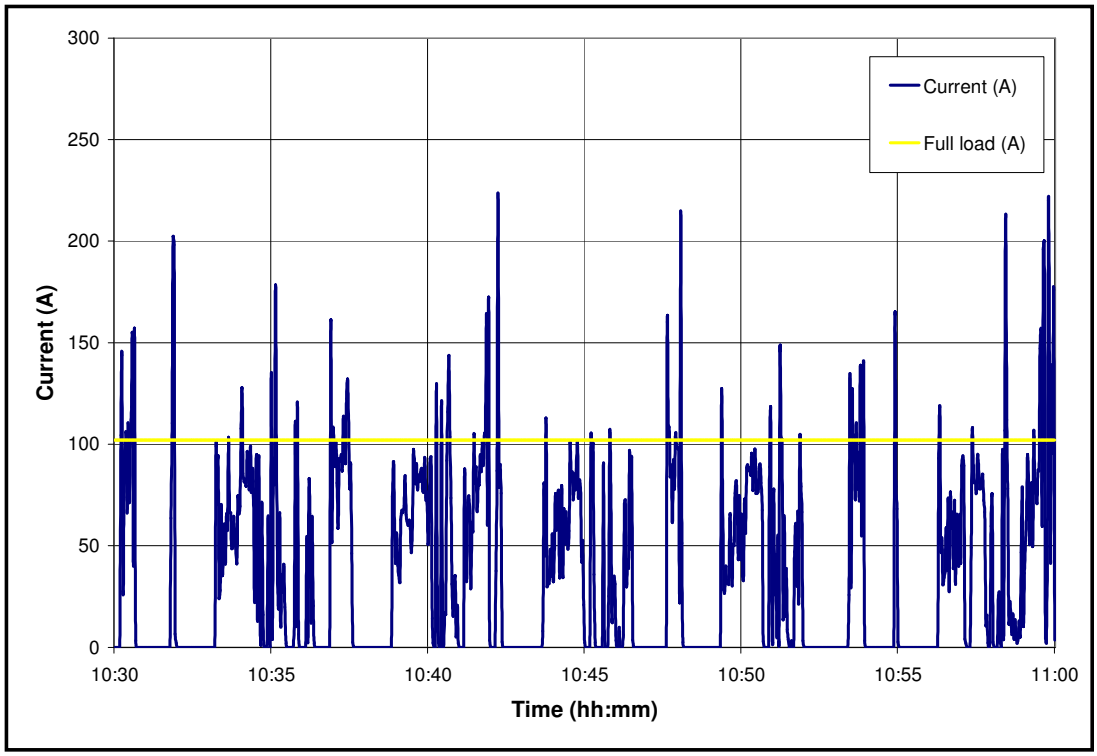

Figure P.1-44: Load current for a LH traction motor – 21 June 2005 (30 minute period).

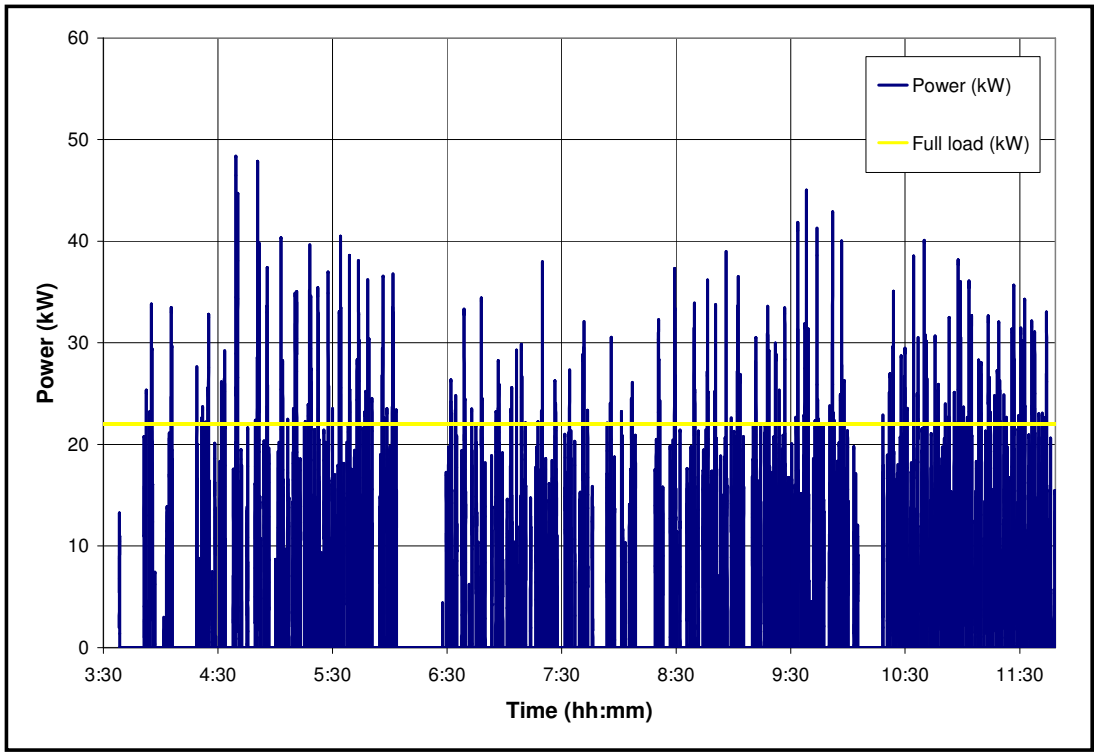

Figure P.1-45: Load power for a RH traction motor – 21 June 2005.

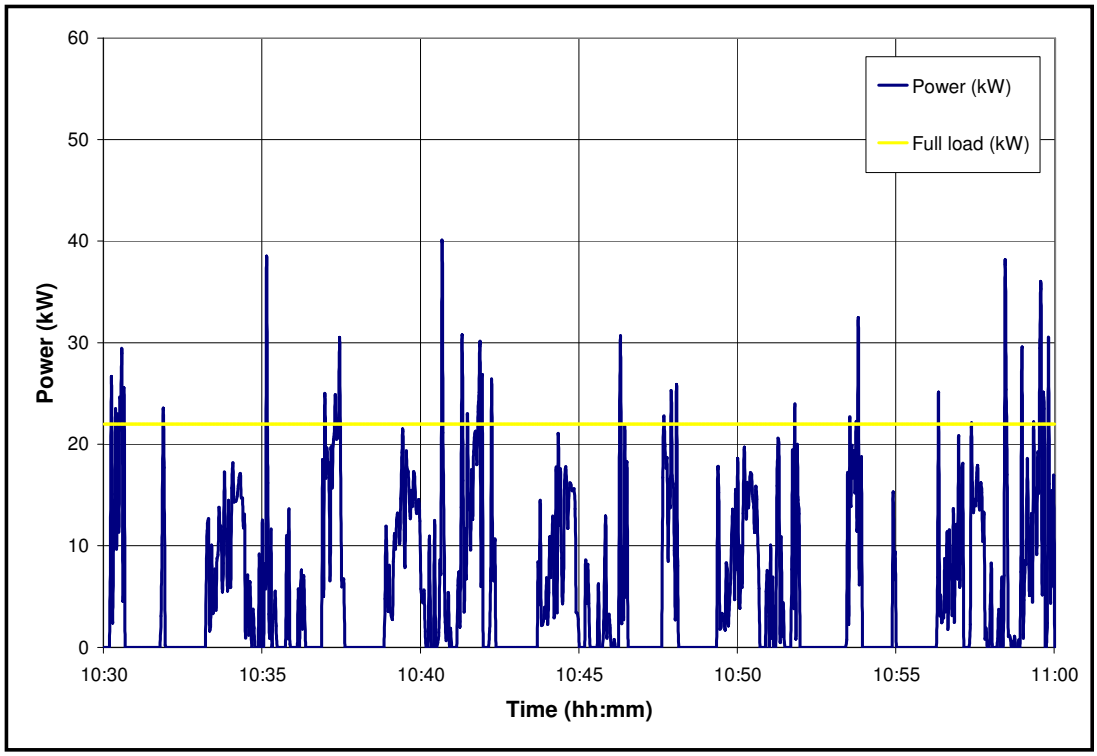

Figure P.1-46: Load power for a RH traction motor – 21 June 2005 (30 minute period).

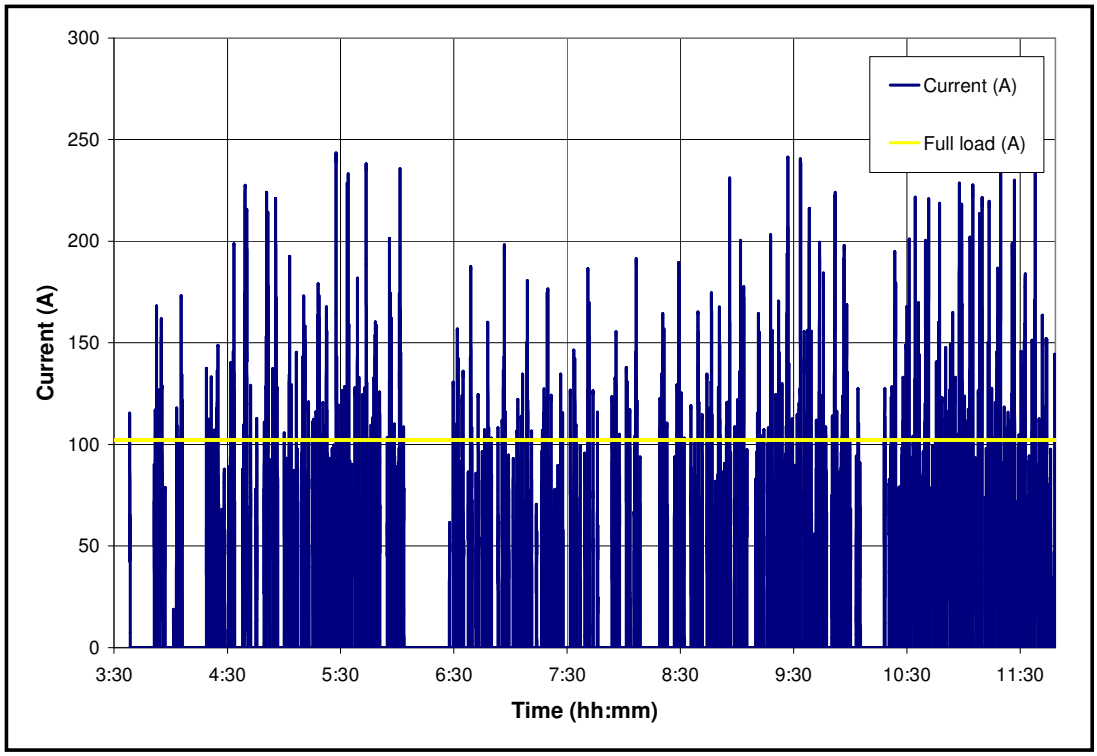

Figure P.1-47: Load current for a RH traction motor – 21 June 2005.

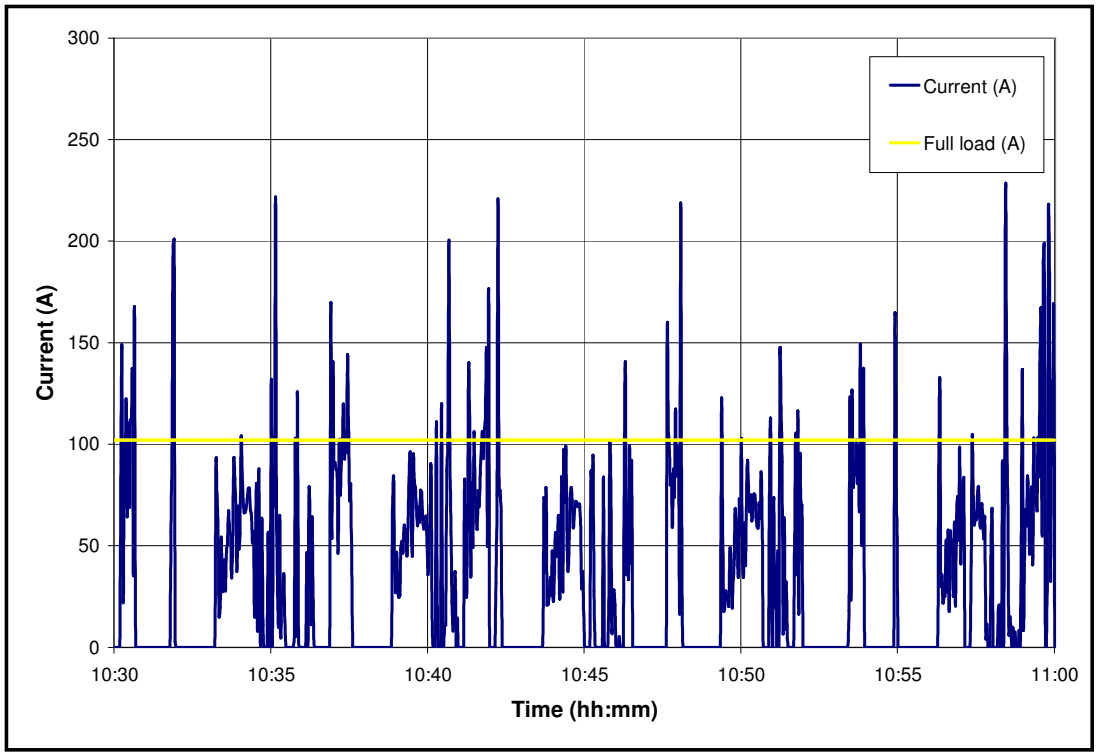

Figure P.1-48: Load current for a RH traction motor – 21 June 2005 (30 minute period).

P.2 HISTOGRAM

The next section focuses on the frequency with which a Shuttle cars traction motors consumed a certain load power and current. The graphs show the number of times a certain power or current has been consumed. The tables give data about the tonnes produced during the shift and the percentage time of the shift that the motors were producing. The time that the motors have been over loaded or loaded within the full load rating of the motor is given as a percentage of the actual producing time. The morning shifts and afternoon shifts are separated as well as the measurements made at the different sections.

P.2.1 SECTION 50

P.2.1.1 Morning shifts

Table P-3: Data for the total consumption of a LH traction motor in section 50.

	4-Jul-05
Tonnes/CM/Shift	1800
% Time of shift producing	25.90%
% of Production time underloaded	72.64%
% of Production time overloaded	27.36%

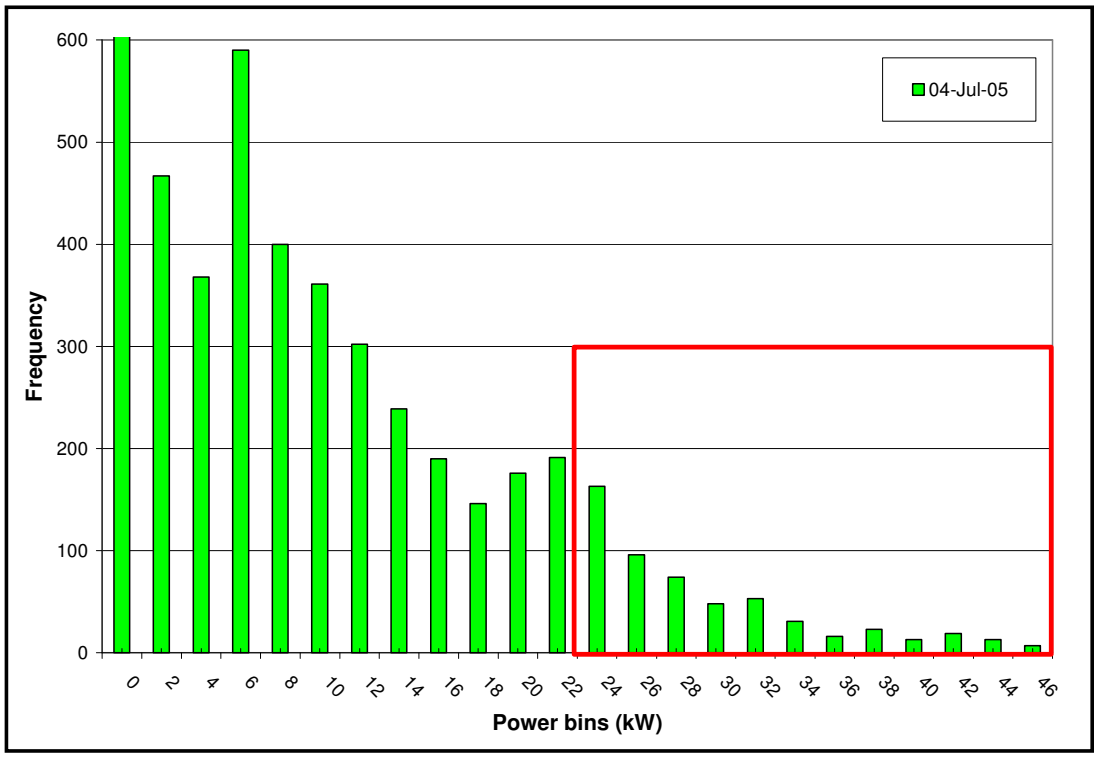

Figure P.2-1: Histogram for power consumed by a LH traction motor.

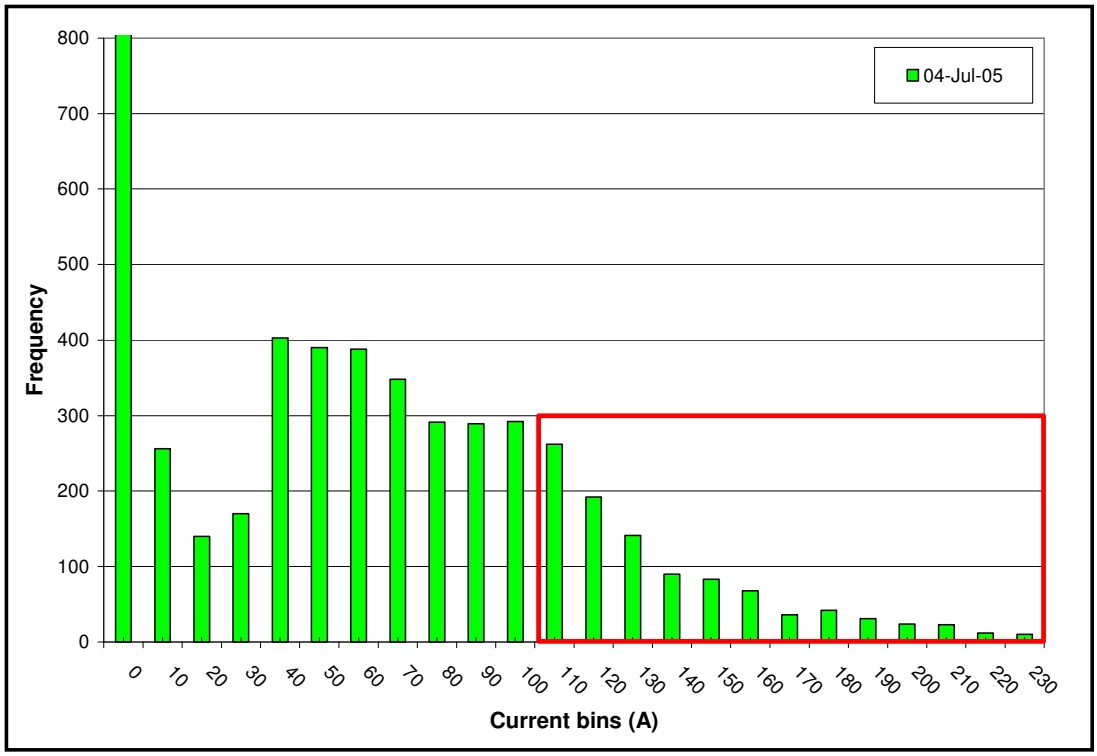

Figure P.2-2: Histogram for current consumed by a LH traction motor.

Table P-4: Data for the total consumption of a RH traction motor in section 50.

	4-Jul-05
Tonnes/CM/Shift	1800
% Time of shift producing	25.44%
% of Production time underloaded	75.90%
% of Production time overloaded	25.10%

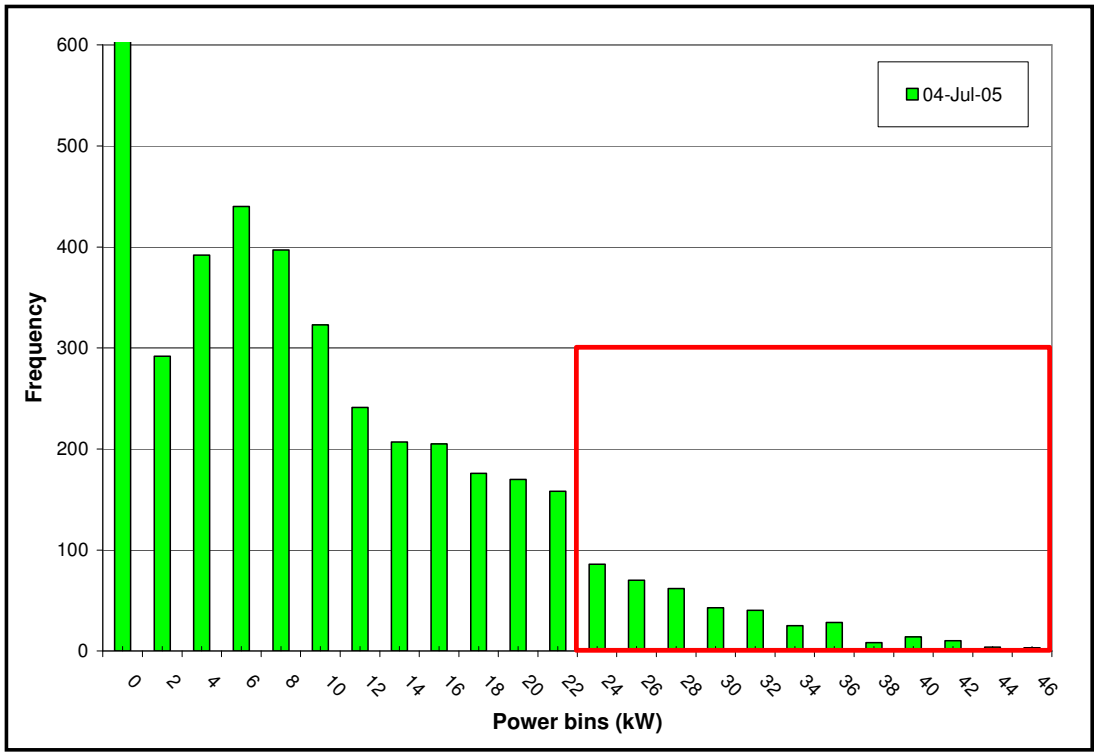

Figure P.2-3: Histogram for power consumed by a RH S traction motor.

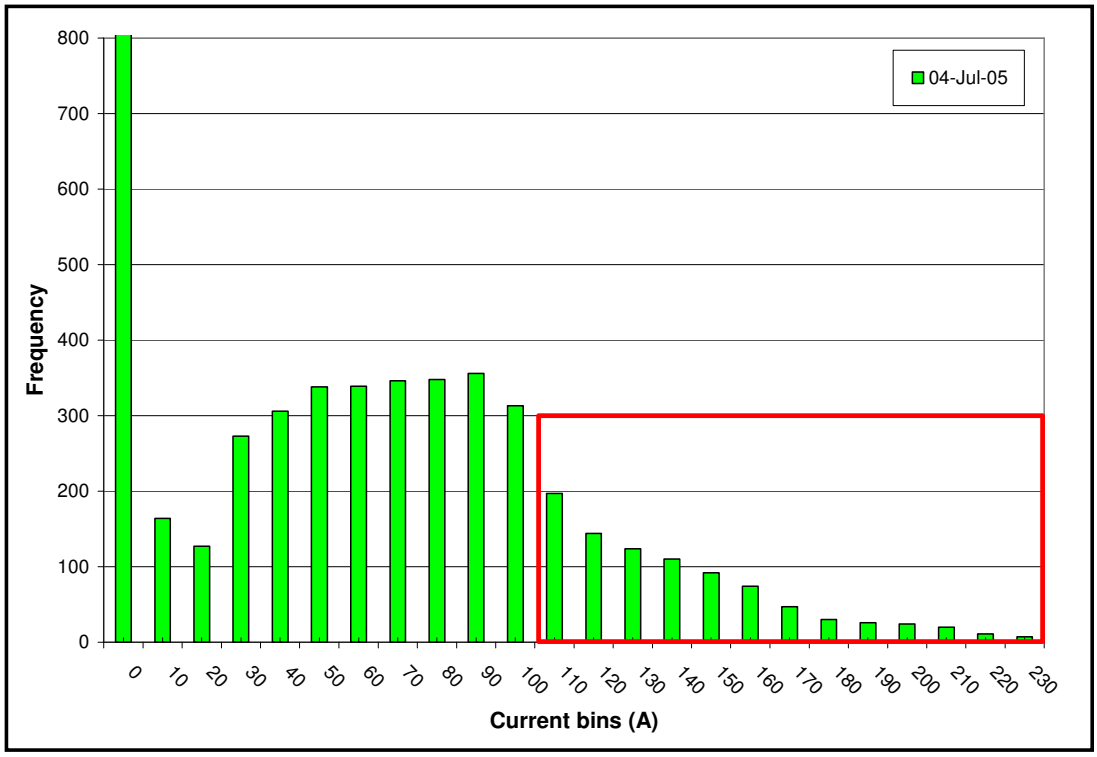

Figure P.2-4: Histogram for current consumed by a RH traction motor.

P.2.1.2 Afternoon shifts

Table P-5: Data for the total consumption of a LH traction motor in section 50.

	4-Jul-05
Tonnes/CM/Shift	2124
% Time of shift producing	22.40%
% of Production time underloaded	69.34%
% of Production time overloaded	30.66%

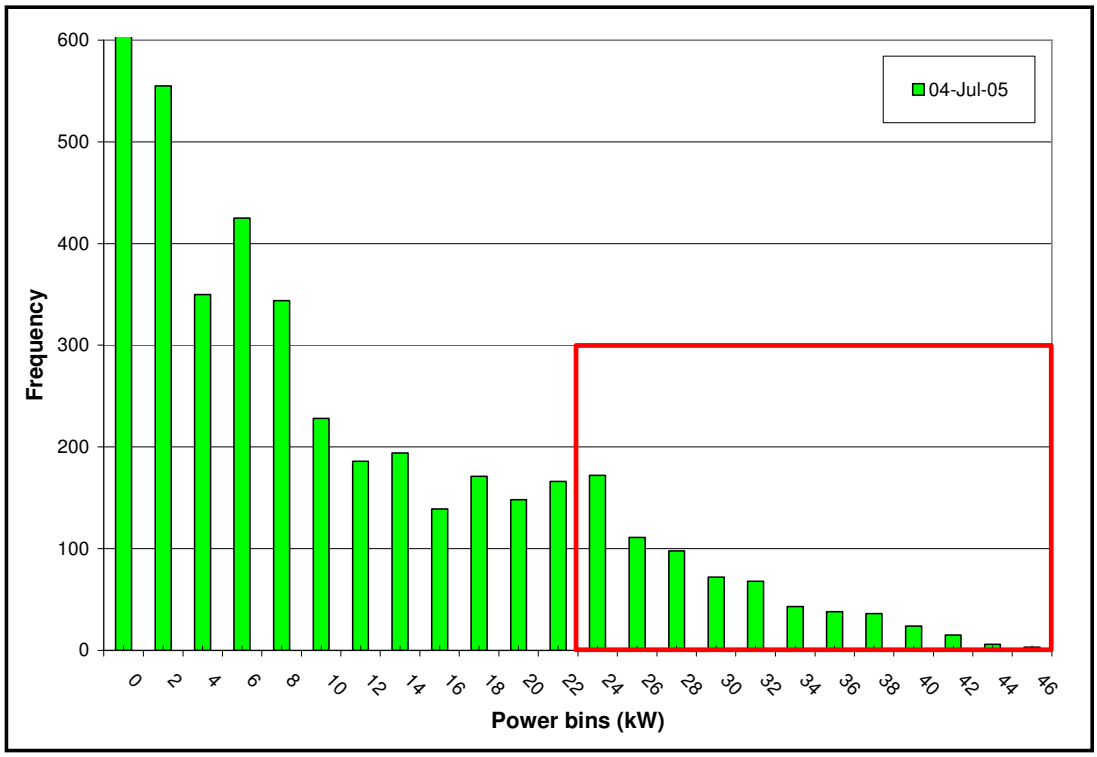

Figure P.2-5: Histogram for power consumed by a LH traction motor.

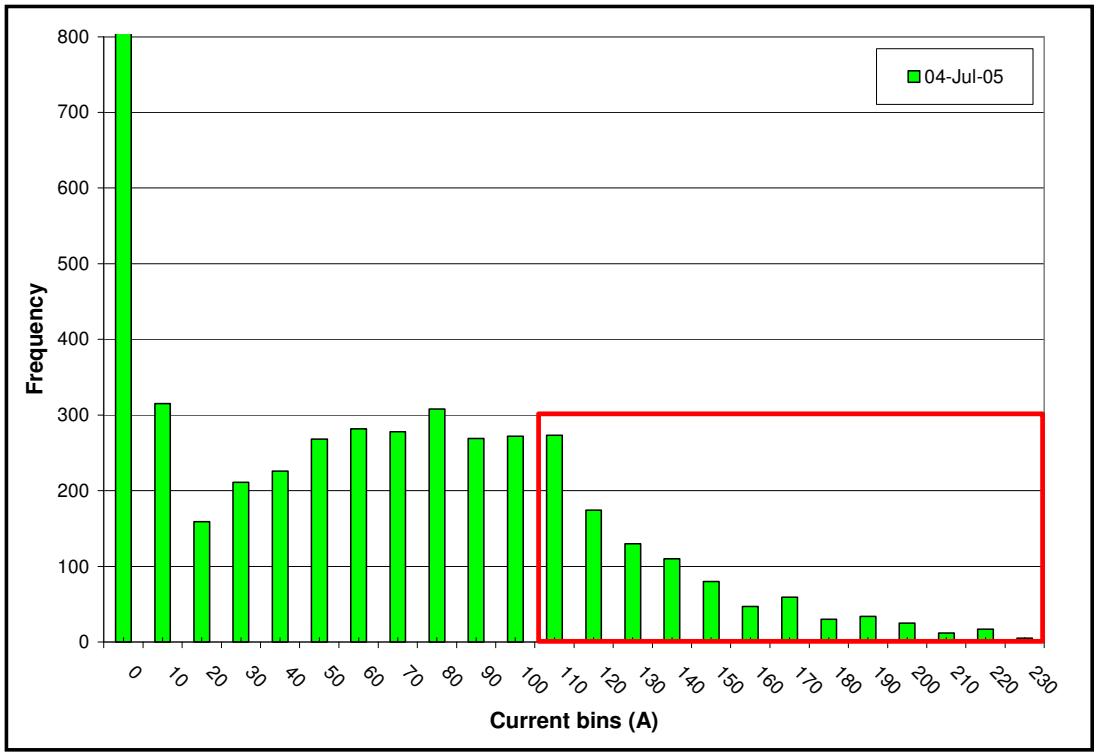

Figure P.2-6: Histogram for current consumed by a LH traction motor.

Table P-6: Data for the total consumption of a RH traction motor in section 50.

	4-Jul-05
Tonnes/CM/Shift	2124
% Time of shift producing	21.96%
% of Production time underloaded	66.95%
% of Production time overloaded	33.05%

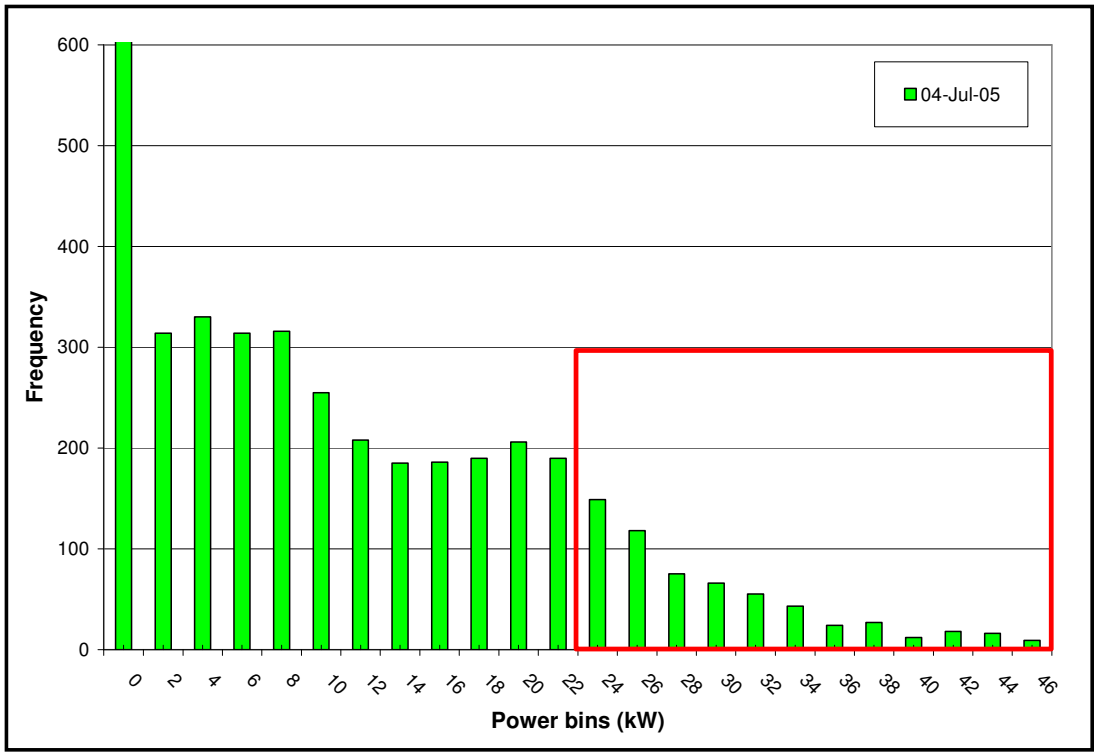

Figure P.2-7: Histogram for power consumed by a RH traction motor.

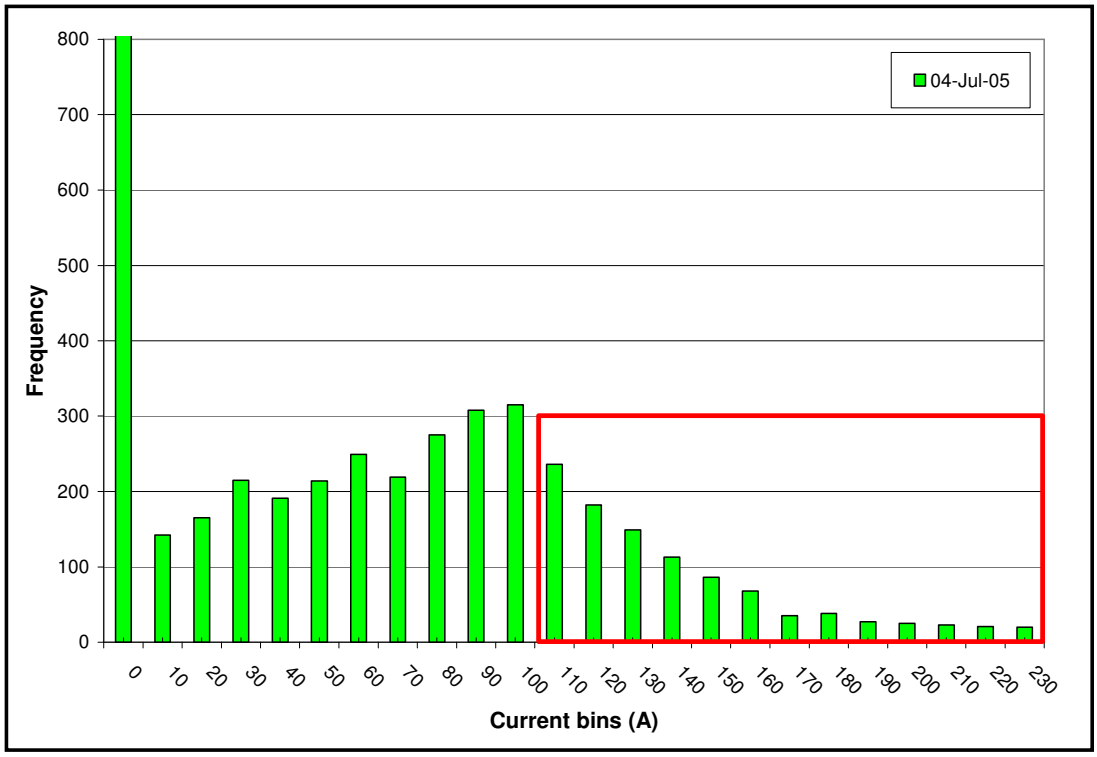

Figure P.2-8: Histogram for current consumed by a RH traction motor.

P.2.2 SECTION 51

P.2.2.1 Morning shifts

Table P-7: Data for the total consumption of a LH traction motor in section 51.

	20-Jun-05	21-Jun-05
Tonnes/CM/Shift	1200	2030
% Time of shift producing	17.65%	29.34%
% of Production time underloaded	73.12%	73.11%
% of Production time overloaded	26.88%	26.89%

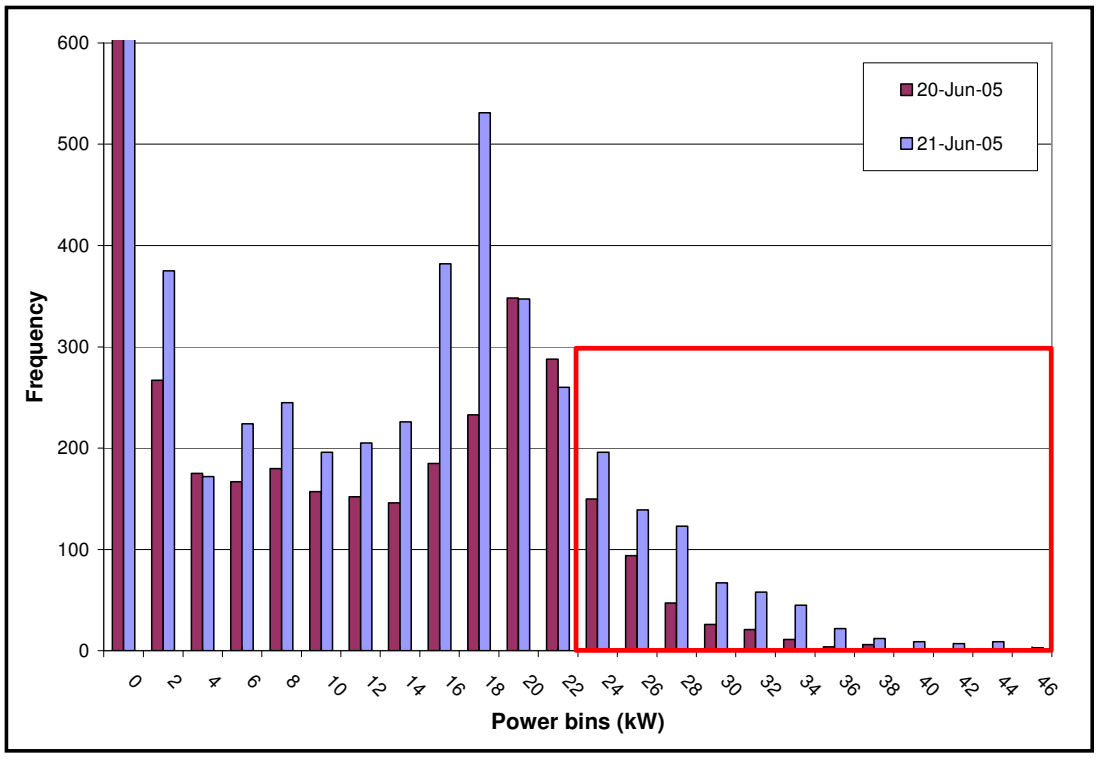

Figure P.2-9: Histogram for power consumed by a LH traction motor.

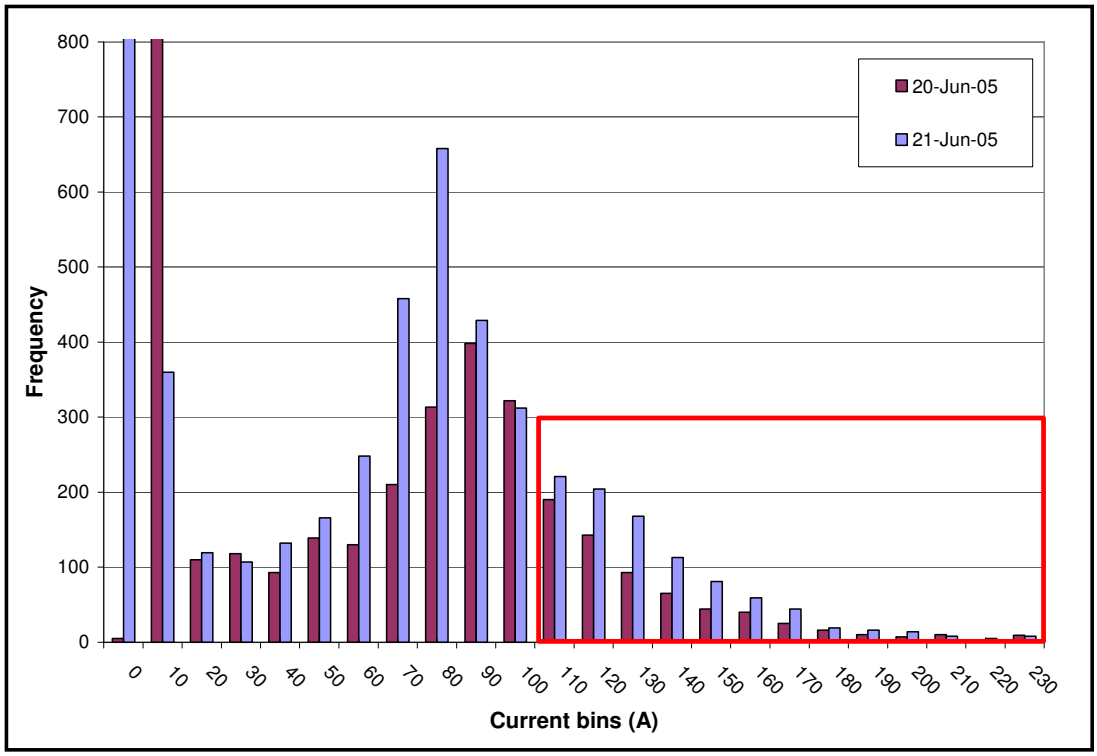

Figure P.2-10: Histogram for current consumed by a LH S traction motor.

Table P-8: Data for the total consumption of a RH traction motor in section 51.

	20-Jun-05	21-Jun-05
Tonnes/CM/Shift	1200	2030
% Time of shift producing	15.44%	28.77%
% of Production time underloaded	84.35%	80.29%
% of Production time overloaded	15.65%	19.71%

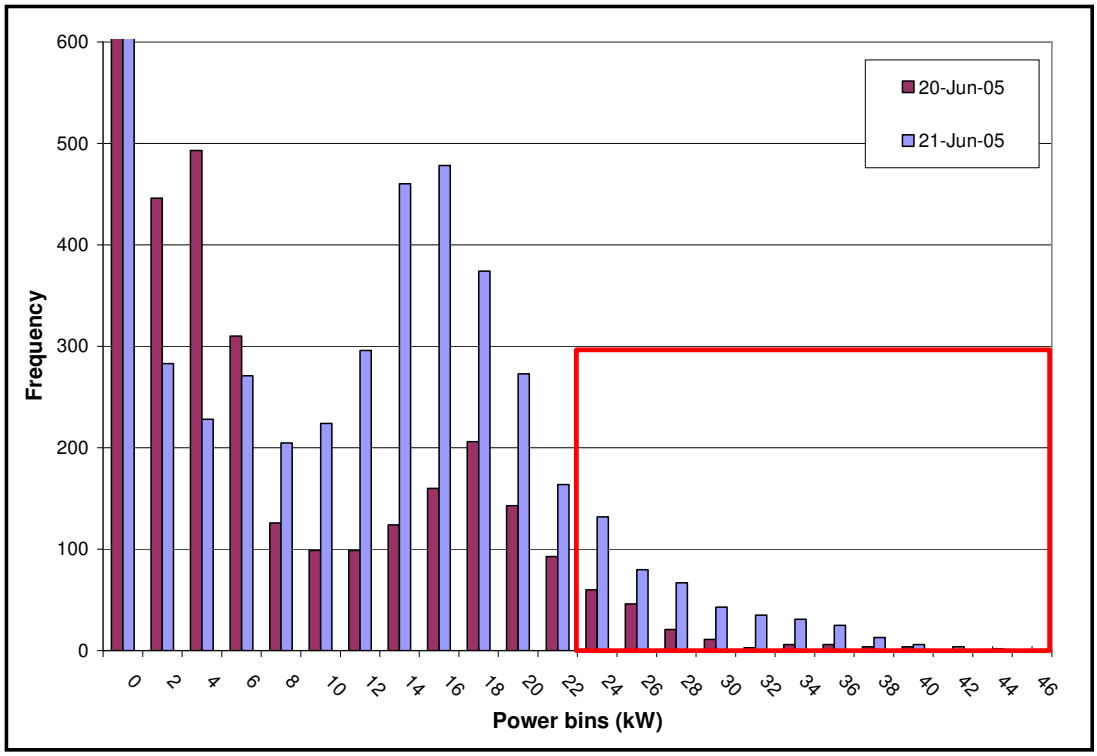

Figure P.2-11: Histogram for power consumed by a RH traction motor.

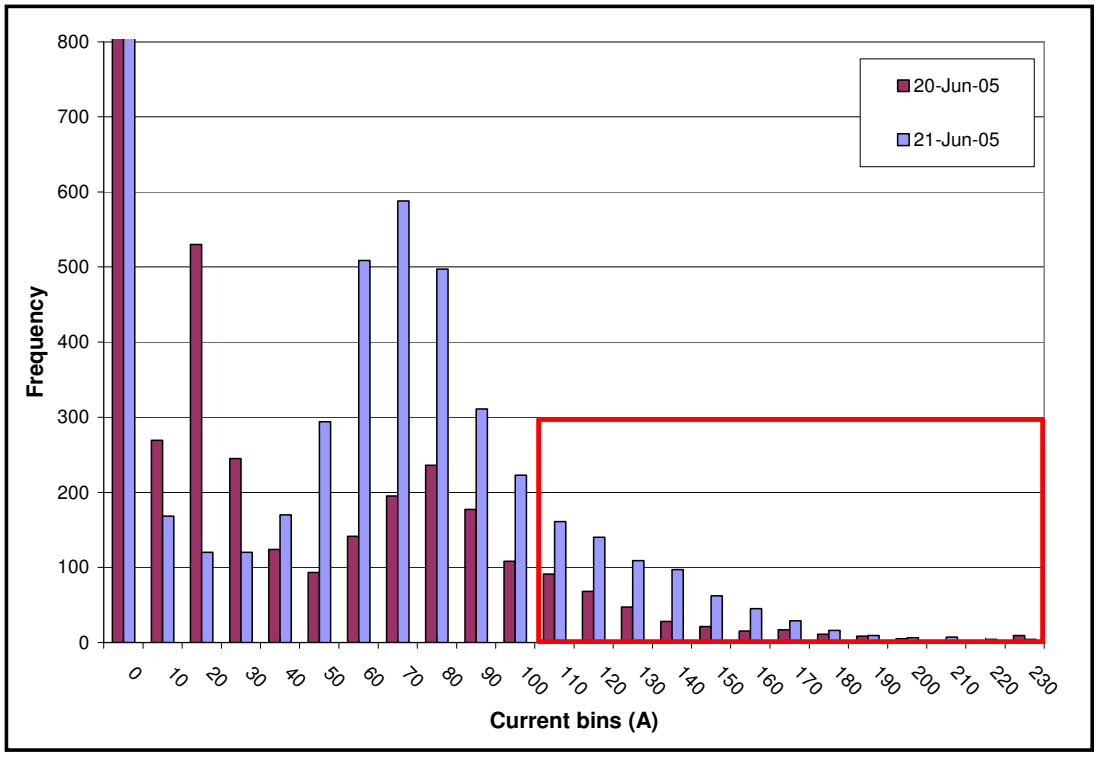

Figure P.2-12: Histogram for current consumed by a RH traction motor.

P.2.2.2 Afternoon shifts

Table P-9: Data for the total consumption of a LH traction motor in section 51.

	20-Jun-05	21-Jun-05
Tonnes/CM/Shift	1890	2320
% Time of shift producing	30.53%	31.66%
% of Production time underloaded	81.35%	79.80%
% of Production time overloaded	18.65%	20.20%

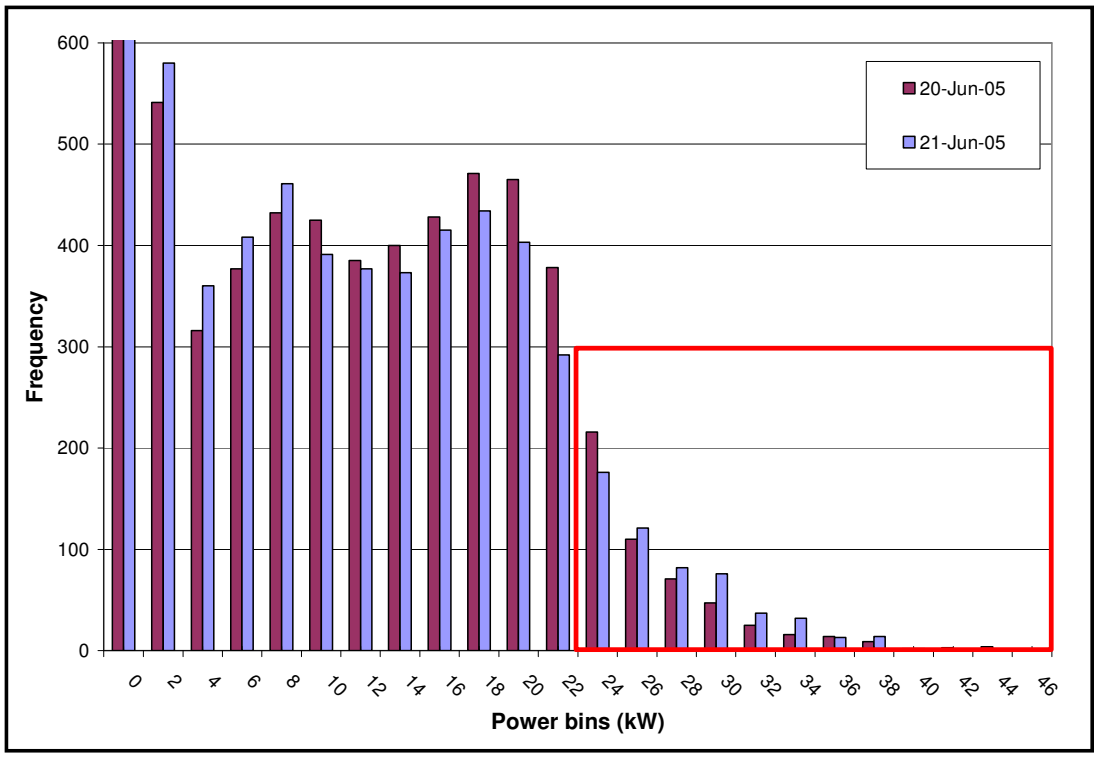

Figure P.2-13: Histogram for power consumed by a LH traction motor.

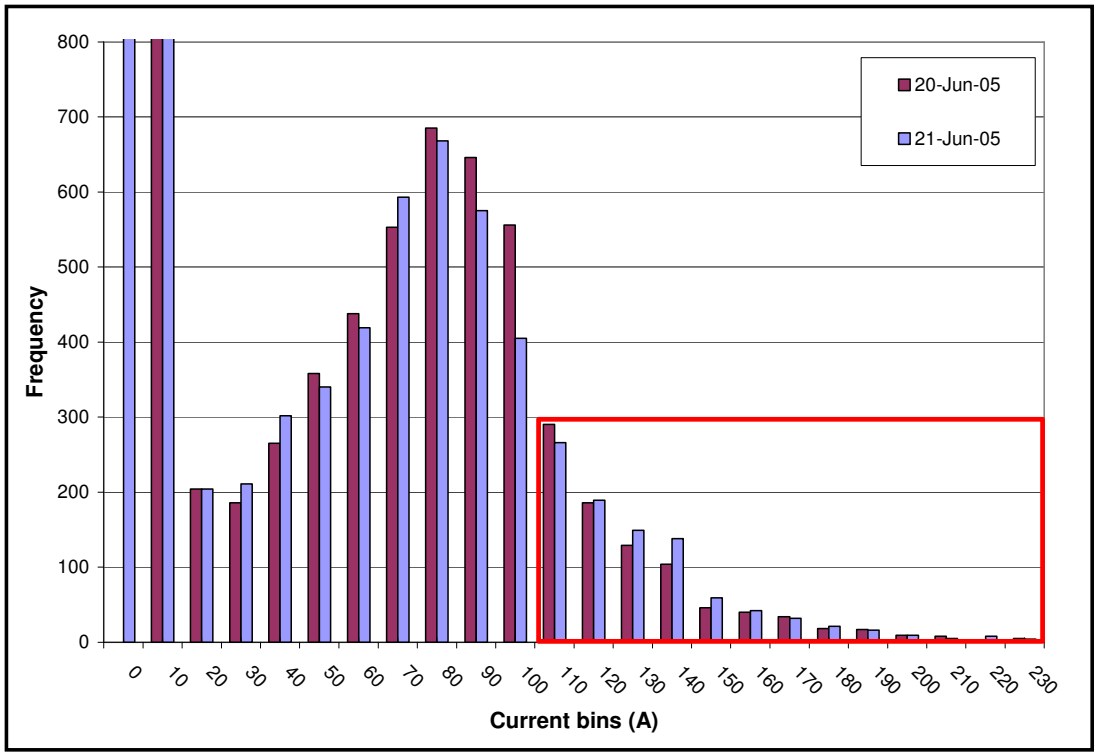

Figure P.2-14: Histogram for current consumed by a LH traction motor.

Table P-10: Data for the total consumption of a RH traction motor in section 51.

	20-Jun-05	21-Jun-05
Tonnes/CM/Shift	1890	2320
% Time of shift producing	6.35%	30.83%
% of Production time underloaded	100.00%	83.82%
% of Production time overloaded	0.00%	16.18%

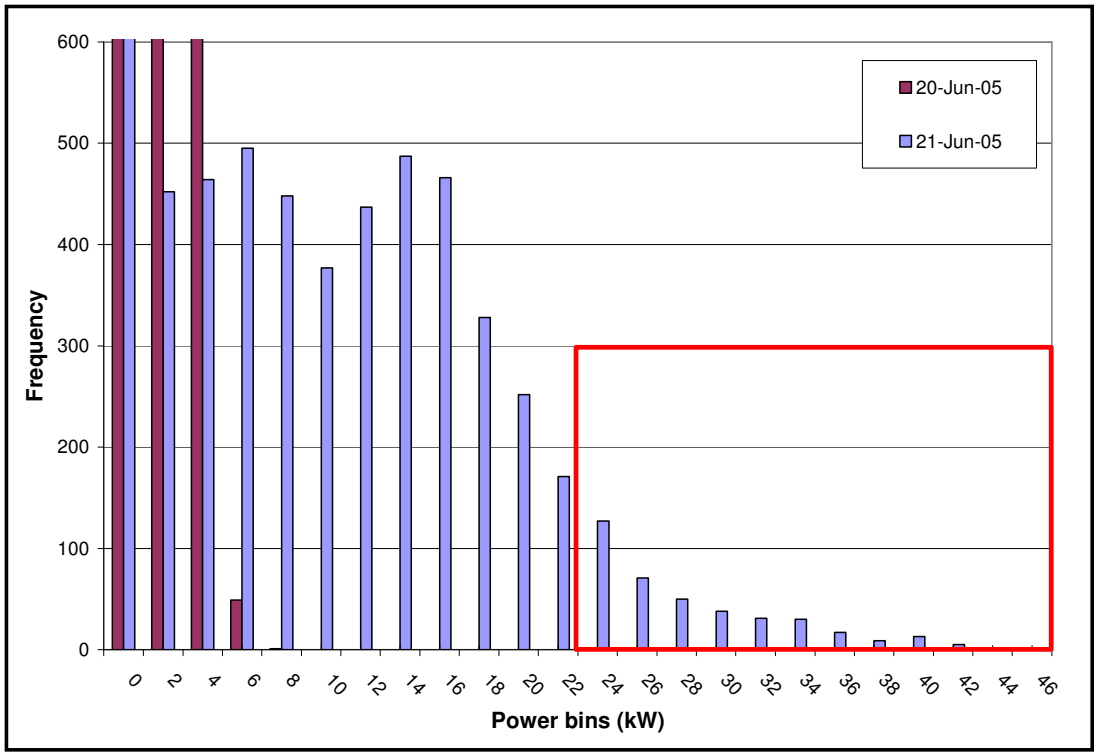

Figure P.2-15: Histogram for power consumed by a RH traction motor.

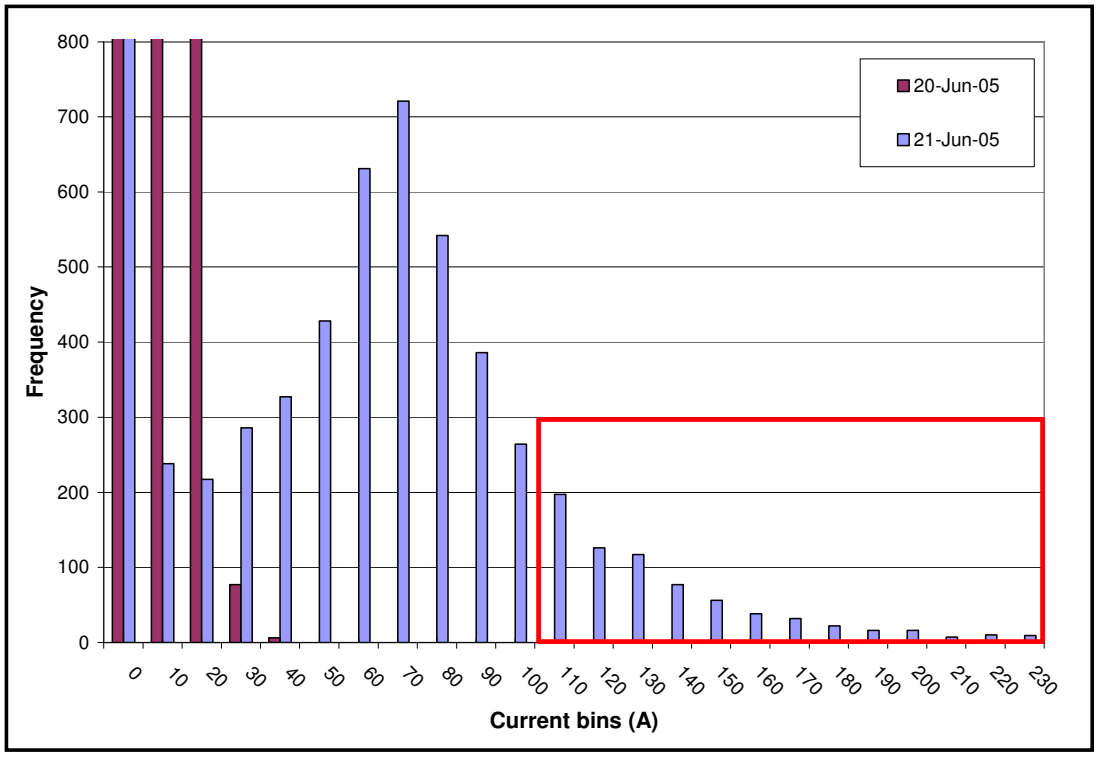

Figure P.2-16: Histogram for current consumed by a RH traction motor.

P.3 THERMAL CAPACITY

The next section focuses on the temperature of the windings of the traction motors. Each graph shows the temperature of the motor, the load current and rated full load current of the motor. The morning shifts and afternoon shifts are separated as well as the measurements made at the different sections. The thermal time constant is 30 minutes.

P.3.1 SECTION 50

P.3.1.1 Morning shifts

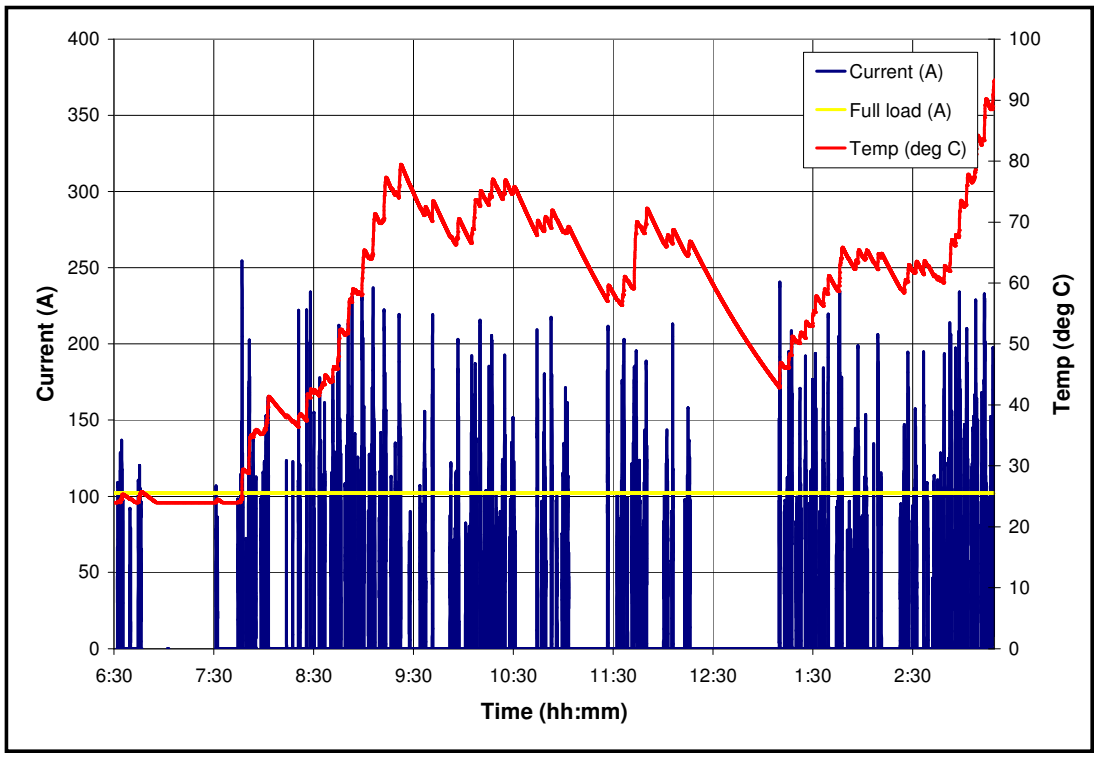

Figure P.3-1: Load current and motor temperature for a LH traction motor – 04 July 2005.

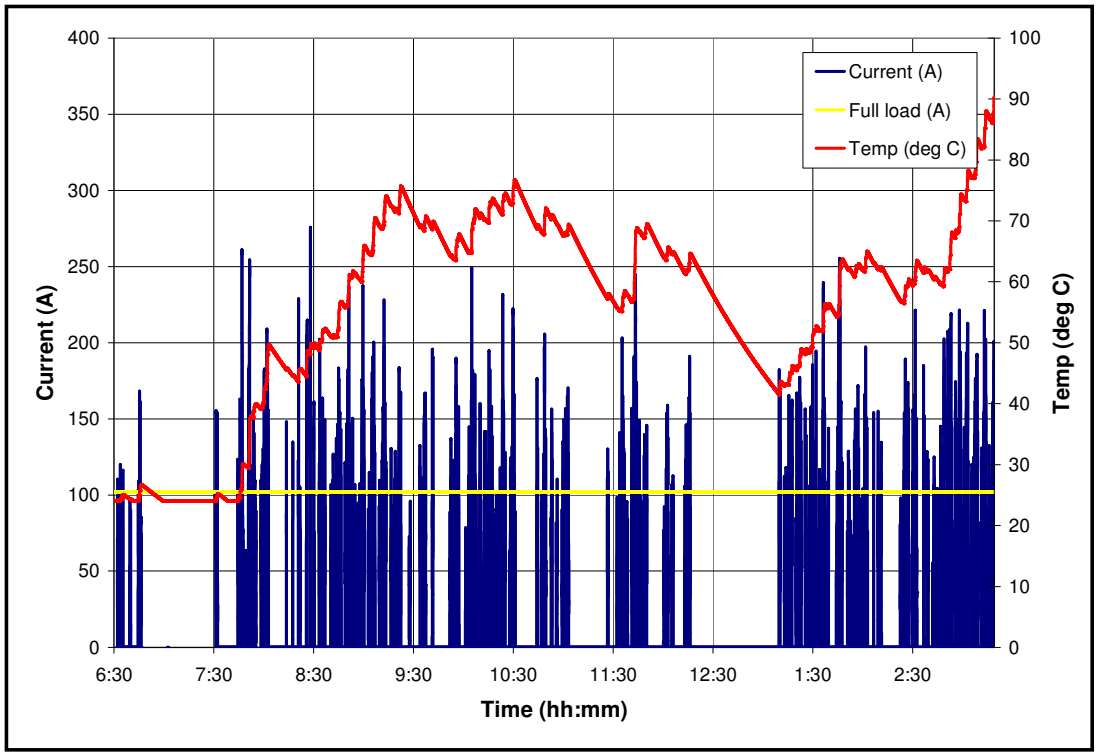

Figure P.3-2: Load current and motor temperature for a RH traction motor – 04 July 2005

P.3.1.2 Afternoon shifts

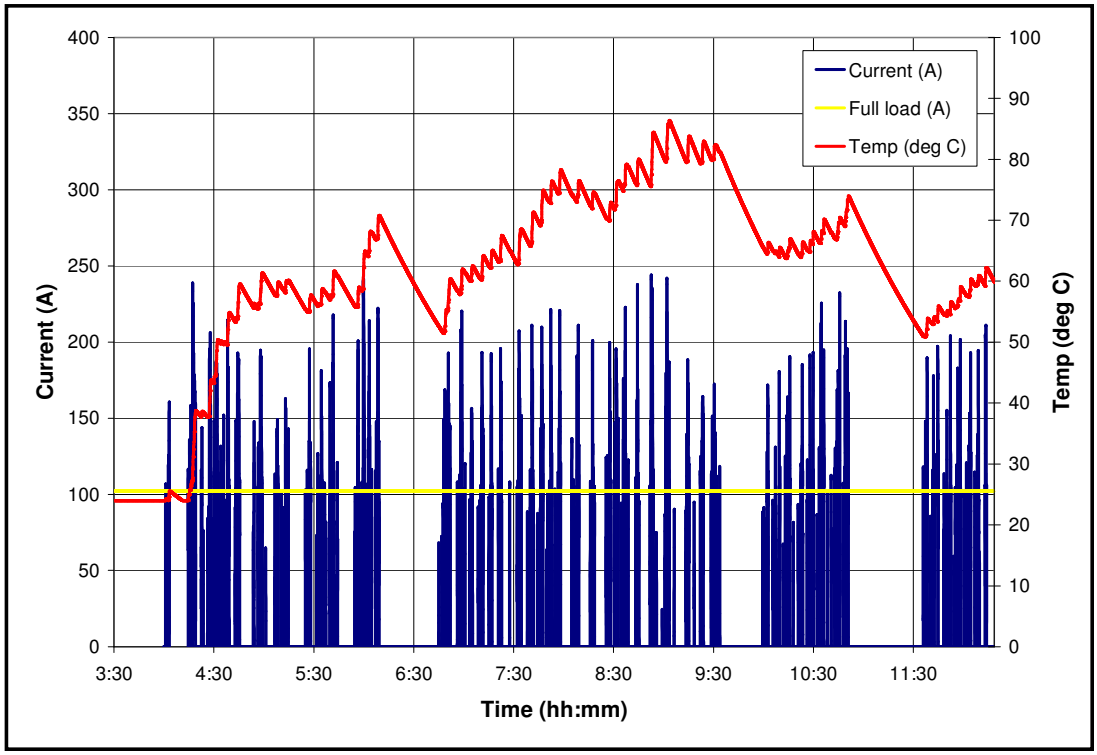

Figure P.3-3: Load current and motor temperature for a LH traction motor – 04 July 2005.

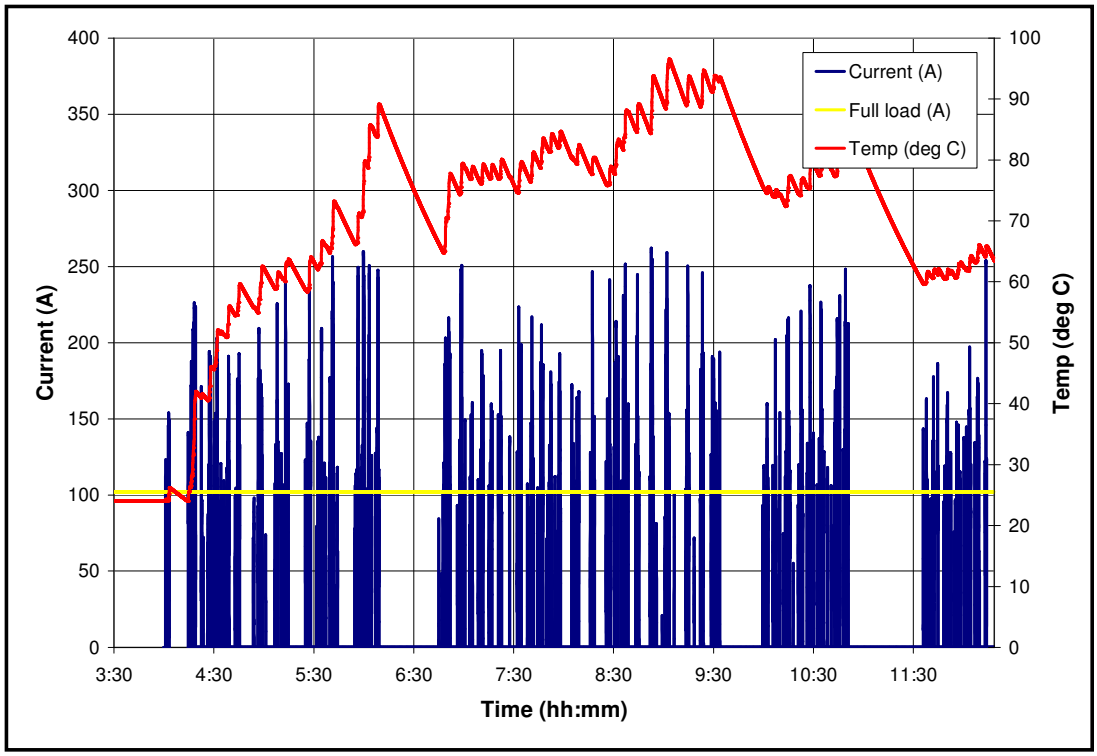

Figure P.3-4: Load current and motor temperature for a RH traction motor – 04 July 2005.

P.3.2 SECTION 51

P.3.2.1 Morning shifts

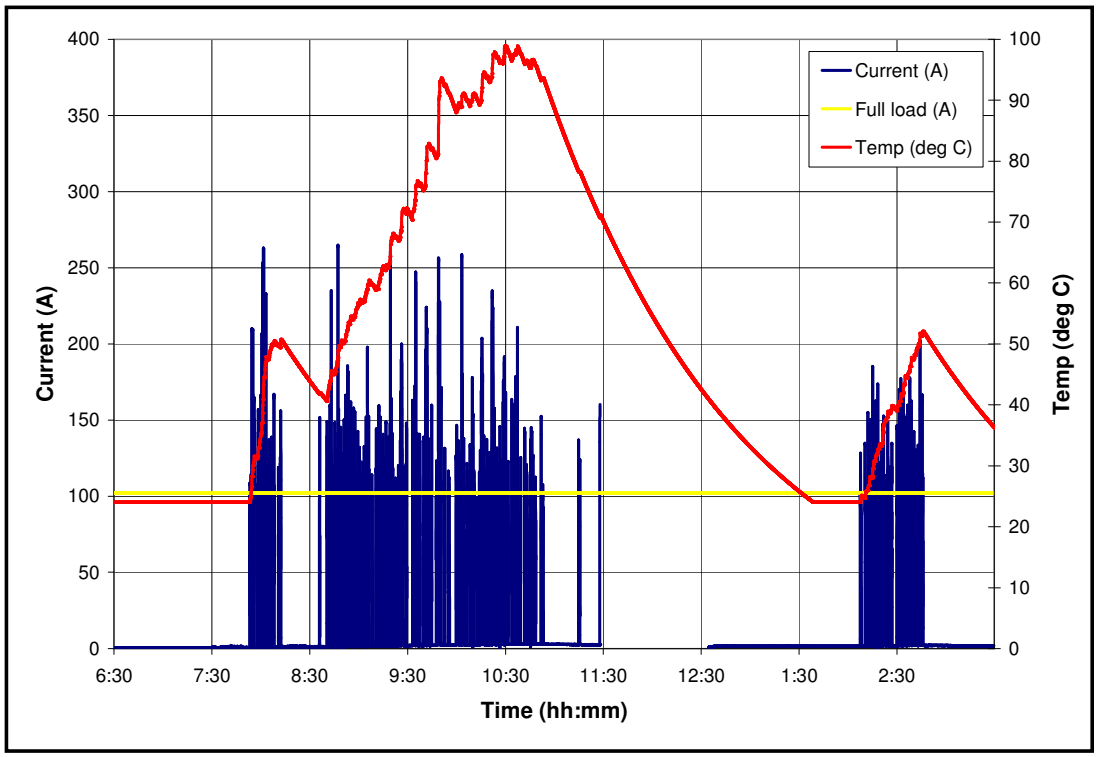

Figure P.3-5: Load current and motor temperature for a LH traction motor – 20 June 2005.

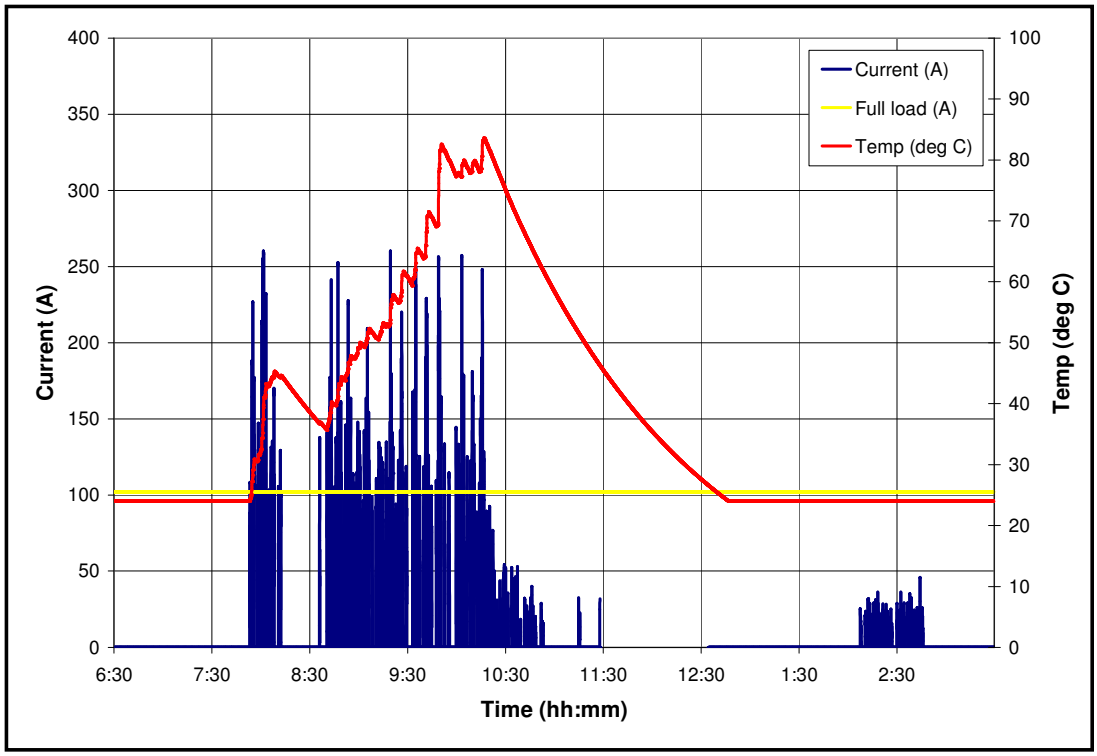

Figure P.3-6: Load current and motor temperature for a RH traction motor – 20 June 2005.

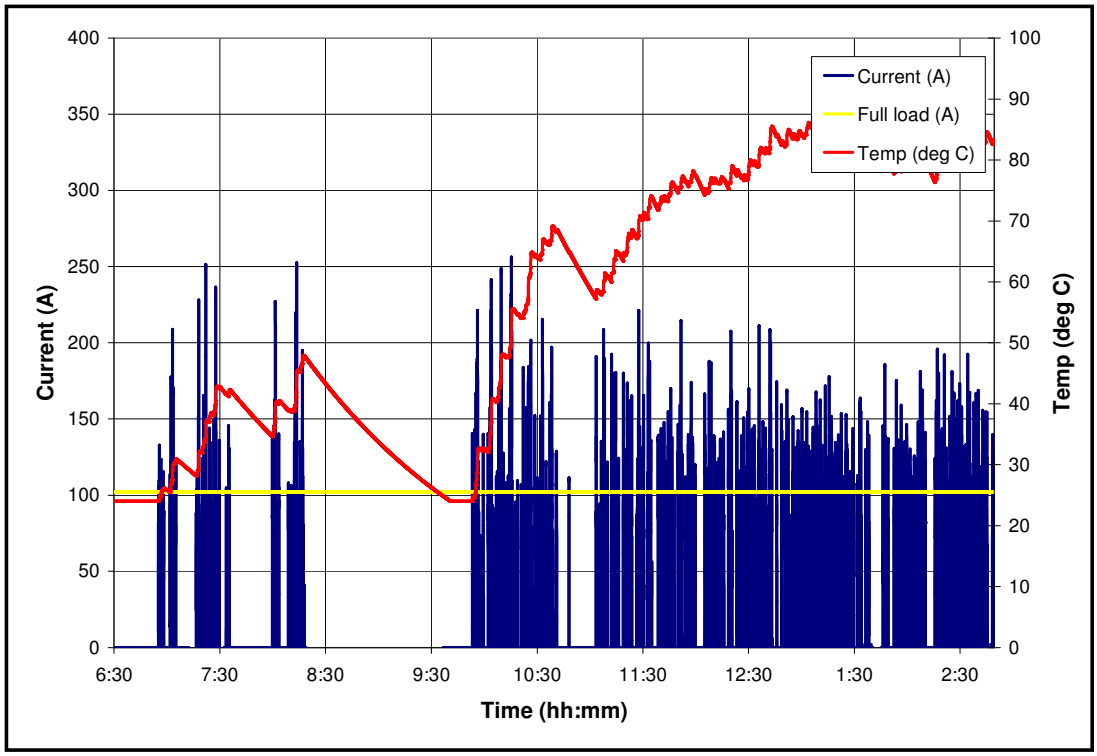

Figure P.3-7: Load current and motor temperature for a LH traction motor – 21 June 2005.

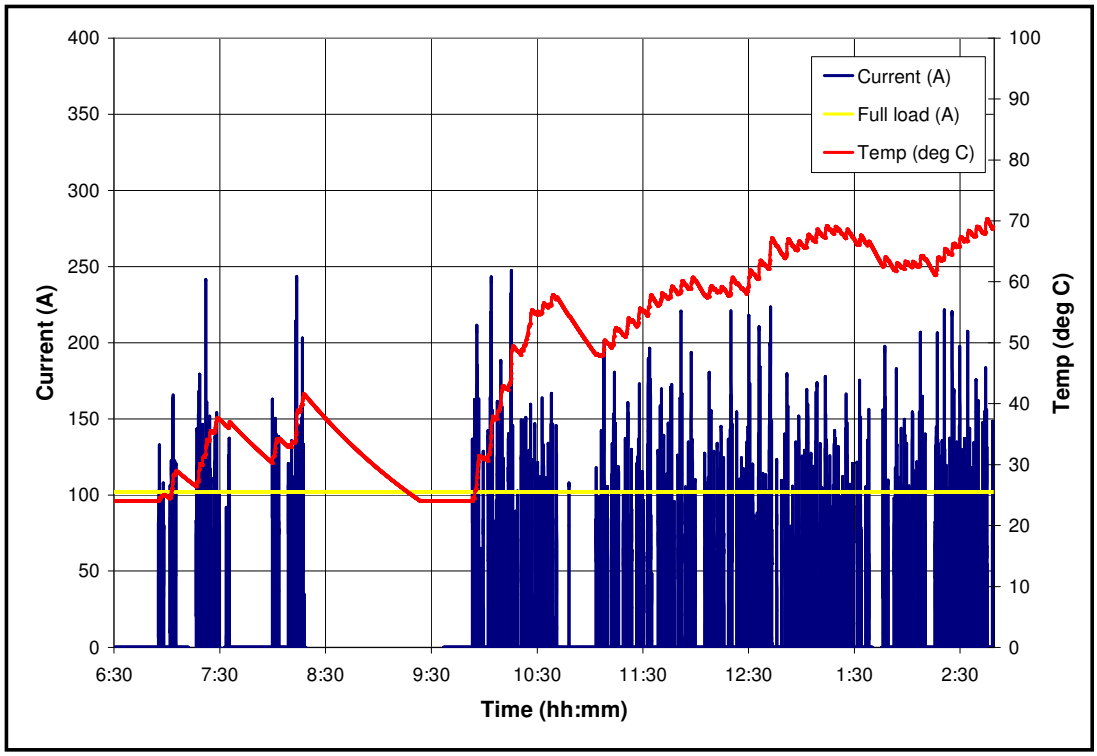

Figure P.3-8: Load current and motor temperature for a RH traction motor – 21 June 2005

P.3.2.2 Afternoon shifts

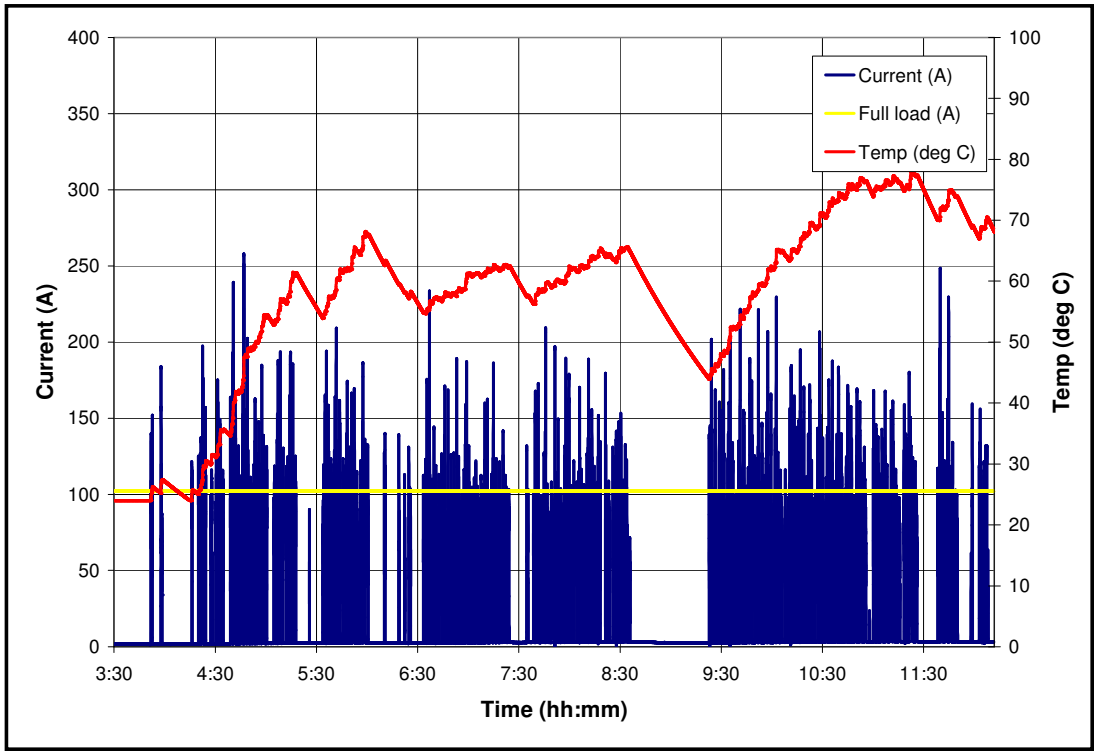

Figure P.3-9: Load current and motor temperature for a LH traction motor – 20 June 2005.

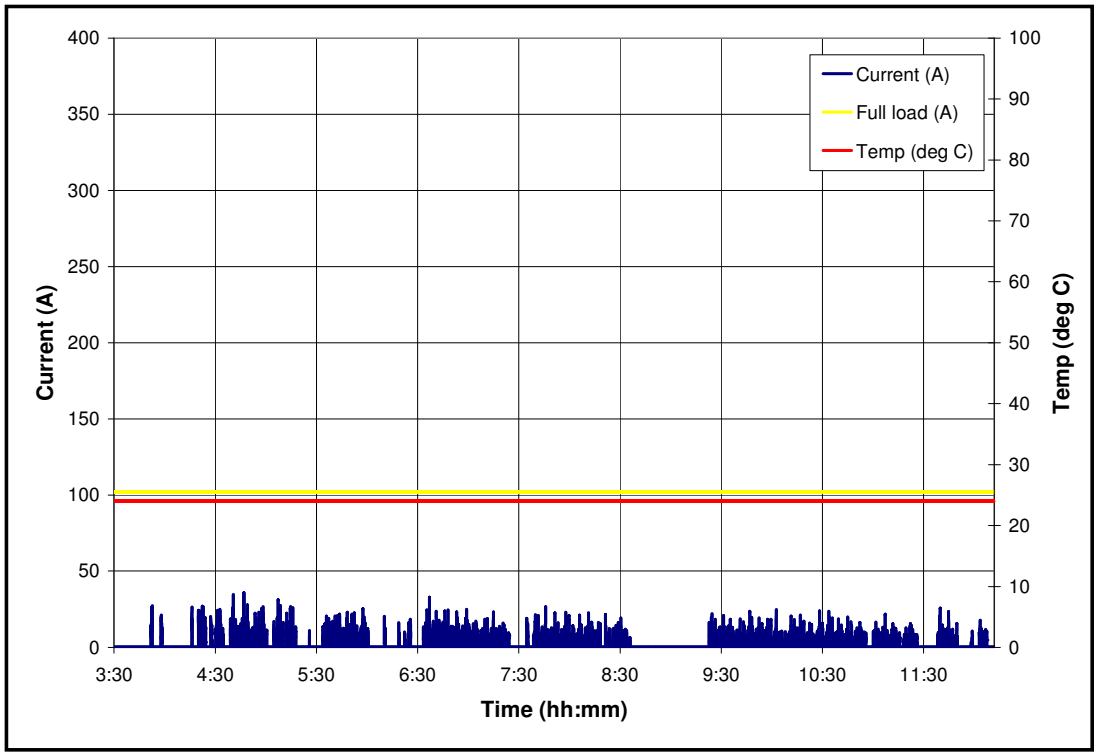

Figure P.3-10: Load current and motor temperature for a RH traction motor – 20 June 2005.

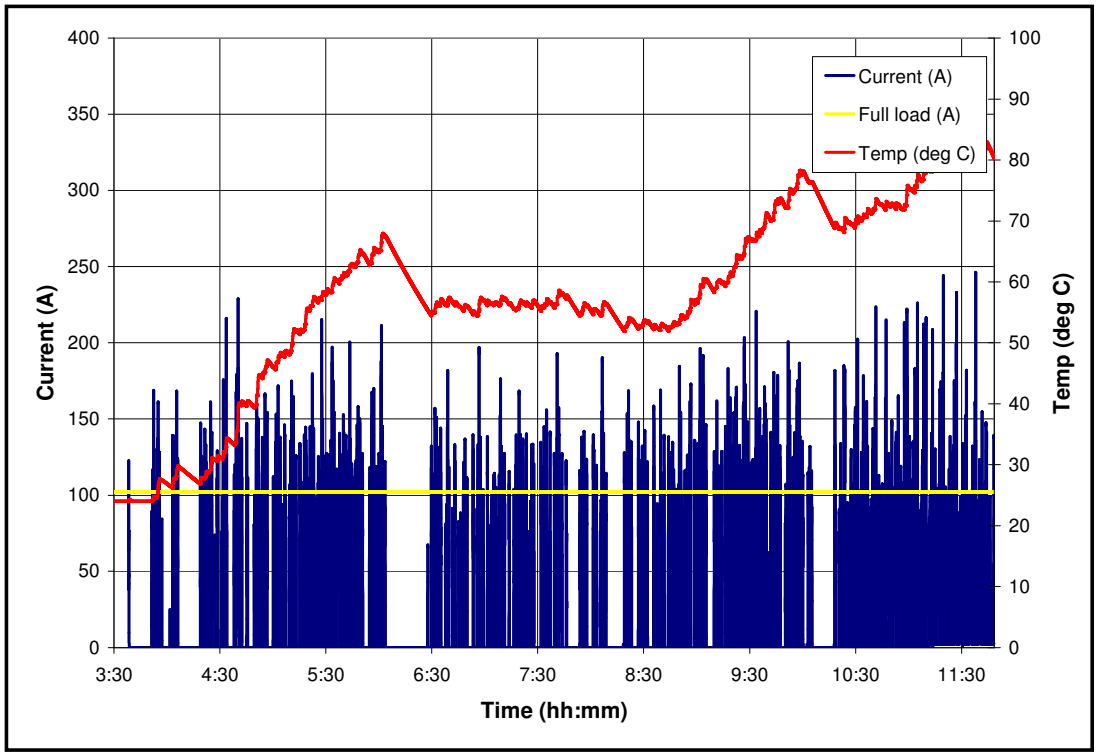

Figure P.3-11: Load current and motor temperature for a LH traction motor – 21 June 2005.

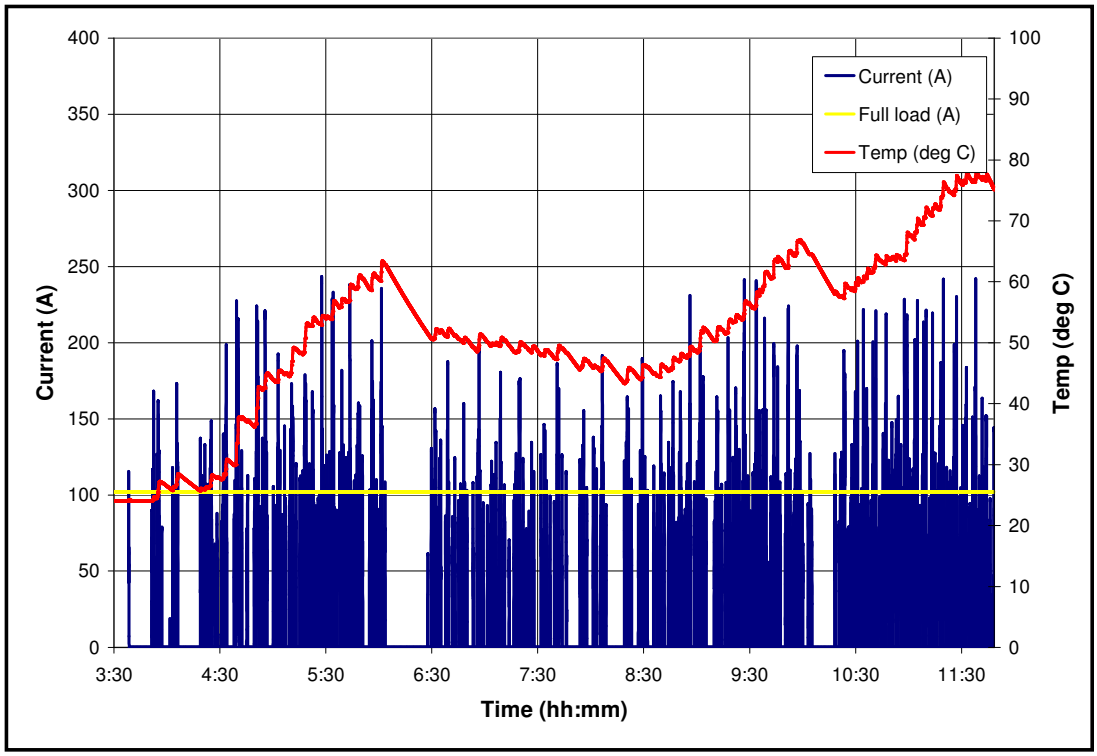

Figure P.3-12: Load current and motor temperature for a RH traction motor – 21 June 2005.