

LPM 2006

Field performance summary

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V1.0 4/12/07

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1. Introduction

This report gives an analysis of the 2006 performance of the eleven BAS LPMs operating on the plateau. Also mentioned but analysed in less detail are the performance of the system at Rothera and the four systems operated by the Japanese National Antarctic Institute for Polar Research.

The site positions, names and deployment dates are given in appendix 1.

Recommendations and comments about future work are given in section 6.

As data coverage was very low this year – discussed in section 2.1 – this report is thinner than usual.

2.1 Performance summary

In general a disastrous year – most of the BAS sites were running with new SiliconDrive industrial PCMCIA cards and these more or less failed to collect any data. Fortunately two sites were operating with the last of the SanDisk cards and these collected a whole years worth of data.

Tests in Cambridge have been able to duplicate the fault. The cards that are currently in the field in 2007 are Pretec Industrial and have passed extensive testing in Cambridge. It should be noted that the PCMCIA cards were the only component of hardware or software that changed in 2006.

The twelve BAS systems (11 deep field + Rothera) operated 756 days from a possible estimate of 4337, that is 17.4%.

A figure that gives a good indication of the success (or otherwise) of the year is the percentage of data at 1s resolution compared to that possible if all the systems worked without problems and continuously at 1s sampling – for BAS this figure was 17.3% in 2006 compared with 91% in 2005, 83% in 2004, 100% in 2003 and 51% in 2002.

More encouragingly the Japanese NIPR system M74/043 set a new record of 444 continuous days of operation with no problems.

2.2 Basic Performance details

M68/292 – Nursie (Rothera)

No Data – card error.

M78/337 - Dr Leech

Operated from deployment 30/01/06 stopped at 8/02/06. Picked up 22/01/07.

9/357 days possible.

No restarts.

0 missed GPS fix out of 53 possible.

All data at 1s resolution.

M79/336 – Bob

Deployed 29/01/06, operated from 08/06/06 until 20/06/06. Picked up 17/1/07

12/353 days possible.

1 restart.

5 missed GPS fixes out of 61 possible.

5.7 days at 1s resolution.

4.2 days at 10s resolution.

2.6 days at 60s resolution.

M81/338 - A80 – Edmund

No Data – card error. Picked up 17-1-07

M82/003 - A81 - Mrs Miggins

No Data – card error. Picked up 22-1-07

M83/347 – Baldrick

Operated from deployment 29/01/06 until pickup 17/01/07

353/353 days possible.

0 restarts

117 missed GPS fixes out of 2056 possible.

All data at 1s resolution.

M84/336 - Baron Richthoven

Operated from deployment 15/1/06 until pickup 17/01/07

367/367 days possible.

No restarts.

89 missed GPS fixes out of 2149 possible.

All data at 1s resolution.

M85/002 - Lord Melchett

No Data – card error. Picked up 18-12-06

M85/096 - Baby Eating Bishop

No Data – card error. Picked up 18-12-06

M87/028 - Flash Heart

No Data – card error. Picked up 18-12-06

M87/068 - Speckled Jim

Operated from deployment 22/12/05, stopped 23/12/05. Recovered 18/12/06.

2/361 days possible.

No restarts.

0 missed GPS fixes out of 13 possible.

All data at 1s resolution.

M88/316 - Lord Whiteadder

Operated from deployment 21/12/05, stopped 3/1/06. Recovered 12/12/06.

13/356 days possible.

No restarts.

0 missed GPS fixes out of 80 possible.

All data at 1s resolution.

Systems operated by Japanese National Institute of Polar Research.

M69/041 – H100

Has data on card from previous years.

92 restarts.

Data periods:

31/8/05 to 21/09/05
21/9/05 to 30/09/05
1/10/05 to 3/10/05
4/10/05 to 5/10/05
7/10/05 to 8/10/05
10/10/05 to 13/10/05
20/10/05 to 21/10/05
11/11/05 to 12/11/05

15/7/06 to 18/7/06
23/7/06 to 26/7/06
27/7/06 to 28/7/06
28/7/06 to 1/8/06
1/8/06 to 1/8/06
1/8/06 to 2/8/06
5/8/06 to 7/8/06
20/8/06 to 21/8/06
23/8/06 to 24/8/06
24/8/06 to 25/8/06
31/8/06 to 14/9/06
14/9/06 to 23/9/06
29/9/06 to 30/9/06
6/10/06 to 7/10/06
11/10/06 to 12/10/06
12/10/06 to 12/10/06
19/10/06 to 20/10/06
21/10/06 to 21/10/06
22/10/06 to 22/10/06
23/10/06 to 24/10/06
24/10/06 to 24/10/06
25/10/06 to 26/10/06
26/10/06 to 26/10/06

In total 58.2 days at 1s sampling, 7.8 days at 10s and 22.1 days at 60s.
1 missed GPS from 454 possible.

M70/044 - Mizuho

Data from 23/8/05 to 31/10/06.

434 /434 days possible.

0 restarts.

All 2601 GPS fixes successful.

All data at 1s.

M74/043 – MD364

Data from 5/9/05 to 23/11/06.

444/444 days possible.

0 restarts.

197 missed GPS fixes out of 2598 possible.

All data at 1s.

M77/040 – Dome F

Appears to have data from 22/11/05 to 23/10/06

But failed GPS so failed processing.

2.3 Podule positions

Table 1 contains the podule serial number at each site.

| Site | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|----------------------|------|------|------------|--------|---------|--------|--------|
| M78/337 | L01 | L03 | L39/02 | L03/00 | L38/02 | L23/01 | L35/02 |
| M79/336 | L02 | L04 | L40/02 | L06/00 | Iridium | L06/00 | L39/02 |
| M81/338 | L04 | L06 | L37/02 | L22/01 | L39/02 | L22/01 | L33/02 |
| M82/003 | L06 | L07 | L38/02 | L01/00 | L33/02 | L44/04 | L34/02 |
| M83/347 ¹ | L07 | L01 | L41/02 | L23/01 | L34/02 | L35/02 | L42/03 |
| M84/336 | L03 | L05 | L36/02 | L04/00 | L40/02 | L37/02 | L36/02 |
| M85/002 | L05 | L02 | L35/02 | L05/00 | L41/02 | L04/00 | L38/02 |
| M85/096 | NA | L22 | L32/02 | L07/00 | L36/02 | L05/00 | L24/01 |
| M87/028 | NA | L21 | L31/02 | L02/00 | L31/02 | L03/00 | L41/02 |
| M87/069 | NA | L23 | L33/02 | L21/01 | L32/02 | L01/00 | L31/02 |
| M88/316 | NA | L24 | L34/02 | L42/03 | L24/01 | L02/00 | L32/02 |
| Rothera | NA | NA | AFI/L03/00 | L43/03 | L44/04 | L21/01 | ? |

Table 1: Podule locations.

Notes 1: M83/348 was replaced in the 2004/5 season with M83/347, for the purpose of this table both sites have been treated as single one.

2.4 Enclosure Heights.

Table 2 shows the height of the bottom of the enclosure off the snow surface(m).

| Site | 2003/4 | 2004/5 | 2005/6 | 2006/7 | Ave Accumulation | Predict 2007/8 |
|----------------|-------------------|--------|--------------------------------------|--------|------------------|----------------|
| M78/337 | 1.30 | 1.13 | 0.89 | 0.73 | 0.19 | 0.54 |
| M79/336 | 1.07 | 0.91 | 0.63 ¹ /1.68 ² | 1.29 | 0.28 | 1.01 |
| M81/338 | 0.91 | 0.79 | 0.51/1.71 ² | 1.38 | 0.24 | 1.14 |
| M82/003 | 1.67 | 1.58 | 1.61 | 1.24 | 0.03 | 1.10 |
| M83/347 NEW | | 1.74 | 1.68 | 1.66 | 0.04 | 1.62 |
| M83/348 OLD | 0.72 | 0.58 | | | 0.14 | NA |
| M84/336 | 1.75 | missed | 1.77 | 1.68 | 0.04 | 1.64 |
| M85/002 | 1.60 | missed | 0.62/1.72 ² | 1.48 | 0.41 | 1.07 |
| M85/096 | 1.17 | 1.10 | 0.92 | 0.78 | 0.13 | 0.65 |
| M87/028 | 1.60 ¹ | missed | 1.56 | 1.60 | 0.0 | 1.60 |
| M87/069 | 1.20 | 1.03 | 0.97 | 0.87 | 0.11 | 0.76 |
| M88/316 | 0.92 | missed | 0.67/1.62 ² | 1.50 | 0.15 | 1.35 |
| Rothera | N/A | | | | | |

Table 2: Enclosure Heights

Note 1: Estimated.

Note 2: Raised this season.

This suggests M78-337, M85-096 and M87-069 should be raised in the 07/08 season, and it might be beneficial to raise M79-336. M85-002 although low should probably be left as it has been raised already and should be completely dug up on the next raise.

3. Magnetometer data.

The data processing programs (the Degum suite) contain many consistency and quality control checks, some of the values from these checks are tracked from year to year. These are: the average values of the GPS position fixes, the rotation angle of the xyz coordinate frame to get it into hdz coordinate frame (this is calculated from the quietest 24hr period of XYZ, values and their variances tracked), the average H, D and Z values, and their variances. These are all presented in the accompanying LPM_data_processing_results_V1.XLS spreadsheet

Any average or quite period values that are inconsistent with previous years and the IGRF model are highlighted in red in the spreadsheet. Data from these periods has been examined and has been replaced with the erroneous data value 9999.9 and marked with bit 5 of the status byte (One or more components have been replaced post-processing).

No data was found to be erroneous in 2006.

To date, the following data contains replaced samples:

| Station | Year | Replaced Data |
|----------------|-------------|--|
| M67-292 | 2004 | All Z samples and H, D samples from 04/11/04 onwards |
| M67-292 | 2005 | All H, D and Z samples |
| M88-316 | 2005 | All H and D samples |

Table 3 Replaced erroneous data

It is likely that the M67-292 system had a faulty sensor or sensor cable (as the fault is multi-year) and this was replaced in the 2006/7 season. Data from 2007 should show if this has been fixed.

In 2005, it was thought that M88-316 might have either a faulty sensor/cable or faulty logger– as the small amount of data in 2006 showed no problem - the working assumption is that the fault lies within the logger L24/01.

4.0 Housekeeping data.

As in 2005, in 2006 the loggers recorded housekeeping every 4 hours, compared with every 6 hours in 2004, 12 hours in 2003 and every hour in 2002. This is also the interval between GPS fixes.

Housekeeping data consists of battery voltage, solar panel voltage, wind generator voltage and a variety of temperatures from around the system and the environment.

4.1 Temperature data

Temperature data recorded are:

- a/ Outside temperature – measured behind solar panel.
- b/ Enclosure temperature – in most instances identical to outside temperature.
- c/ Logger temperature.
- d/ 1m depth snow temperature – useful as an indication of magnetometer temperature.
- e/ First battery box temperature.

Table 4 is a summary of the temperature information from each site.

The Logger Min is the minimum temperature recorded in the logger electronics, M85-096 has the coldest operational temperature so far at -78.8°C which it reached in both 2003 and 2005. The intention is to put a meteorological grade temperature sensor on this site and M87-069.

‘Ave Delta’ is the difference between the average logger temperature and the average outside temperature, a positive temperature indicates the logger is warmer than the outside.

The battery minimum and maximum show the extreme of temperatures measured within the first battery box. The battery Delta max shows the maximum warming inside the battery box due to charging.

| LPM | Logger Min | Outside Min | Outside Max | Ave Delta | Batt Min | Batt Max | Batt Delta Max | Notes |
|---------|------------|-------------|-------------|-----------|----------|----------|----------------|-------|
| M68-292 | void | void | void | void | void | void | void | 1,2 |
| M78-337 | void | void | void | void | void | void | void | 1,2 |
| M79-336 | void | void | void | void | void | void | void | 1,2 |
| M81-388 | void | void | void | void | void | void | void | 1,2 |
| M82-003 | void | void | void | void | void | void | void | 1 |
| M83-348 | -60.2 | -63.6 | +1.3 | 3.14 | -53.4 | 12.1 | void | |
| M84-336 | -62.2 | -65.1 | -2.1 | 4.03 | -54.4 | +33.1 | +62.0 | 3,4 |
| M85-002 | void | void | void | void | void | void | void | 1 |
| M85-096 | void | void | void | void | void | void | void | 1 |
| M87-028 | void | void | void | void | void | void | void | 1 |
| M87-069 | void | void | void | void | void | void | void | 1 |
| M88-316 | void | void | void | void | void | void | void | 1 |

Table 4a. **2006** temperature information summary.

Note 1, No data.

Note 2, Cellyte rather than Sunlyte batteries.

Note 3, New outside coldest record for this site.

Note 4, Warmest ever battery temperature.

| LPM | Logger Min | Outside Min | Outside Max | Ave Delta | Batt Min | Batt Max | Batt Delta Max | Notes |
|---------|------------|-------------|-------------|-----------|----------|----------|----------------|-------|
| M68-292 | -31.4 | -34.8 | +8.1 | 2.32 | -18.7 | +16.4 | 26.9 | 2 |
| M78-337 | -52.4 | -54.4 | +9.6 | 2.48 | -43.1 | -6.0 | 21.0 | 2 |
| M79-336 | -44.6 | -48.0 | +10.1 | 5.35 | -34.3 | -2.1 | 22.9 | 2 |
| M81-388 | -56.3 | -60.7 | +9.6 | 4.05 | -36.3 | -4.5 | 25.3 | 2 |
| M82-003 | -64.1 | -68.5 | -4.1 | 4.37 | -52.9 | +15.0 | 54.7 | |
| M83-348 | -58.7 | -60.7 | -5.0 | 2.91 | -50.9 | +8.6 | VOID | |
| M84-336 | -56.8 | -59.2 | -8.0 | 3.01 | -50.9 | +30.1 | 60.5 | |
| M85-002 | -72.9 | -75.8 | -8.0 | 3.66 | -60.7 | +30.6 | 68.4 | 3,4 |
| M85-096 | -77.3 | -78.8 | -6.5 | 2.89 | -63.1 | -3.6 | 42.5 | |
| M87-028 | -51.9 | -53.9 | -9.9 | 4.46 | -40.7 | -2.1 | 28.8 | |
| M87-069 | -75.3 | -76.8 | -1.6 | 2.54 | -62.2 | +8.6 | 54.7 | |
| M88-316 | -66.6 | -69.5 | -9.9 | 2.97 | -53.8 | +11.1 | 54.7 | |

Table 4b. **2005** temperature information summary.

Note 2, Cellyte rather than Sunlyte batteries.

Note 3, New outside coldest record for this site.

Note 4, Warmest ever battery temperature.

| LPM | Logger Min | Outside Min | Outside Max | Ave Delta | Batt Min | Batt Max | Batt Delta Max | Notes |
|---------|------------|-------------|-------------|-----------|----------|----------|----------------|-------|
| M68-292 | -23.6 | -25.0 | +11.6 | 1.78 | -14.8 | +10.6 | 14.2 | 1,2 |
| M78-337 | -50.4 | -52.4 | +8.6 | 2.96 | -37.8 | -5.5 | 18.6 | 2 |
| M79-336 | -47.5 | -50.4 | +14.0 | 2.91 | -36.8 | -3.6 | 24.4 | 2 |
| M81-388 | -57.8 | -60.2 | +9.1 | 2.63 | -38.7 | -6.0 | 19.0 | 2 |
| M82-003 | -63.1 | -67.0 | -2.1 | 3.99 | -53.3 | +12.1 | 50.3 | |
| M83-348 | -60.7 | -64.1 | +5.7 | 4.46 | -47.5 | +9.6 | 48.3 | 3 |
| M84-336 | -59.7 | -63.1 | -15.3 | 4.29 | -52.9 | +22.3 | 46.8 | 3 |
| M85-002 | -70.0 | -72.9 | -2.6 | 3.60 | -61.7 | +19.8 | 59.0 | 3 |
| M85-096 | -73.4 | -76.8 | -10.9 | 3.55 | -62.7 | 0.0 | 45.9 | |
| M87-028 | -67.5 | -71.4 | -1.1 | 4.34 | -57.7 | +4.2 | 35.2 | 3 |
| M87-069 | -74.9 | -77.8 | -5.0 | 3.95 | -61.7 | +7.6 | 54.2 | |
| M88-316 | -67.5 | -70.5 | -3.1 | 3.17 | -55.8 | +11.1 | 52.7 | 3 |

Table 4c. **2004** temperature information summary.

Note 1, No previous values.

Note 2, Cellyte rather than Sunlyte batteries.

Note 3, New outside coldest record for this site.

| LPM | Logger Min | Outside Min | Outside Max | Ave Delta | Batt Min | Batt Max | Batt Delta Max | Notes |
|---------|------------|-------------|-------------|-----------|----------|----------|----------------|-------|
| M78-337 | -50.9 | -54.8 | -2.2 | 3.27 | -38.7 | -2.1 | 20.0 | 2, 3 |
| M79-336 | -50.4 | -52.8 | +9.6 | 1.53 | -37.3 | -1.6 | 22.0 | 2 |
| M81-388 | -57.8 | -61.2 | +6.7 | 3.06 | -40.2 | -4.5 | 21.0 | 2 |
| M82-003 | -68.0 | -70.9 | -8.45 | 2.57 | -52.9 | 6.2 | 43.9 | 3 |
| M83-348 | -60.2 | -63.1 | -11.9 | 3.12 | -45.1 | 8.1 | 44.4 | 3 |
| M84-336 | -55.3 | -58.7 | -13.3 | 1.57 | -48.0 | 14.0 | 44.9 | |
| M85-002 | -67.5 | -70.5 | -19.2 | 3.69 | -60.2 | 14.0 | 55.2 | 3 |
| M85-096 | -76.3 | -78.8 | -22.1 | 2.88 | -68.0 | -3.5 | 47.9 | 1,3,4 |
| M87-028 | -65.6 | -69.0 | -13.8 | 3.13 | -57.8 | 2.8 | 43.9 | 1,3 |
| M87-069 | -74.4 | -78.3 | -17.2 | 4.28 | -64.1 | 4.2 | 50.7 | 1,3 |
| M88-316 | -65.1 | -66.5 | -8.0 | 2.67 | -57.3 | 7.2 | 49.8 | 1,3 |

Table 4d. **2003** temperature information summary.

Note 1, No previous outside min temps.

Note 2, Cellyte rather than Sunlyte batteries.

Note 3, New outside coldest record for this site.

Note 4, New absolute outside coldest recorded for any site to 2003.

System M83-347 has a non-working 1m temperature measurement this was also apparent in the 2005 data so the sensor needs replacing.

System M87-068 has a non working temperature sensor in the outer enclosure – this was also apparent in the 2005 data, it should be possible to fix on site but at low priority.

M84-336 and M85-002 both showed very high battery temperatures in 2005. Lack of data from M85-002 in 2005 means that no conclusions can be drawn about that site but M84-336 showed similar high temperatures this year. Figure 1 shows the battery temperature during the year (black) along with the solar panel charge voltage (upper blue, solar panel voltage + 40) and the wind generator charge voltage (lower blue, wind generator charge voltage –80) for M84-336 in 2006. many periods can be seen when the dump box operates (solar voltage pulled down to about 5v) – there does not appear to be any abnormal charging or behaviour associated with the high battery temperatures of last year.

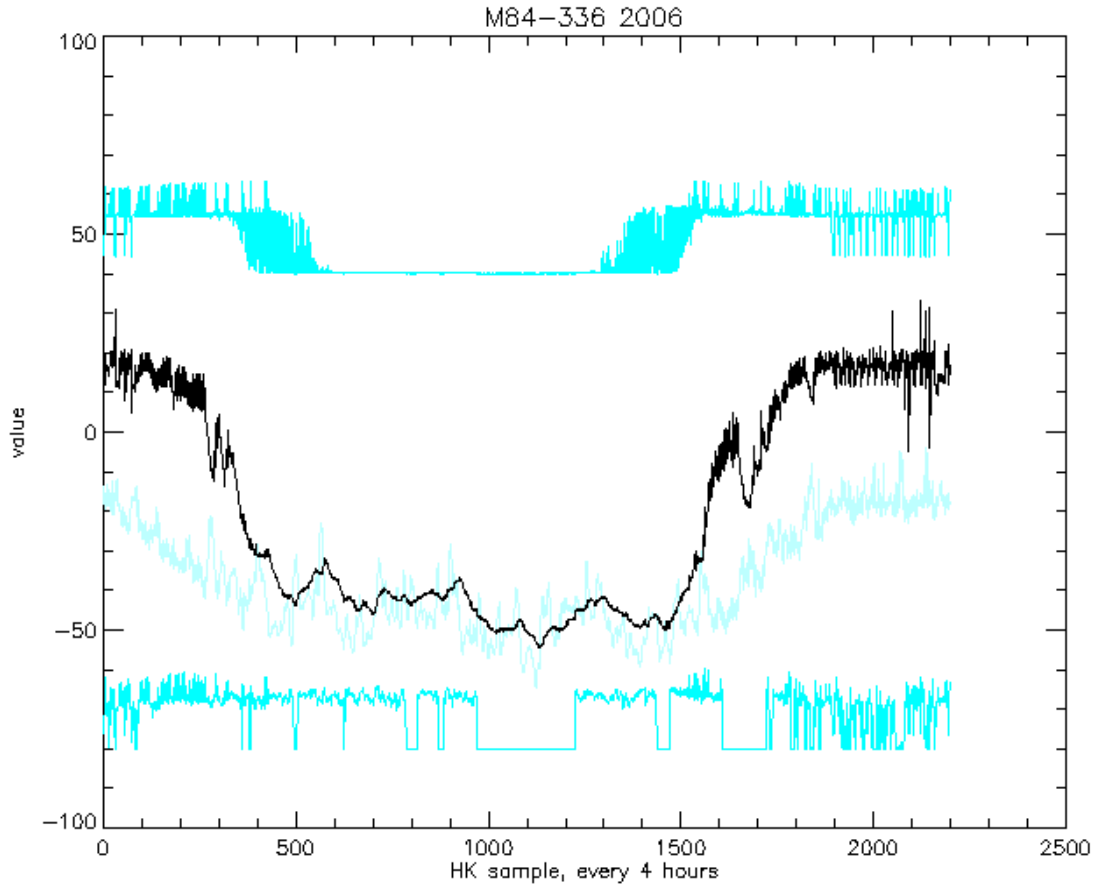


Figure 1, M84-336 battery temperature during the year (black) along with the solar panel charge voltage (upper blue, solar panel voltage + 40) and the wind generator charge voltage (lower blue, wind generator charge voltage -80). External temperature is the light blue line under the battery temperature.

4.2 Battery voltage data

Battery voltage is important as it indicates the charge state of the batteries. If the batteries are too deeply discharged then they will have a shortened life (which could be as short as one discharge in the severe case). As the method of retaining battery charge is to slow down the sampling rate of the magnetometer, too conservative estimation of battery voltage will result in reduced high resolution data coverage.

Voltage itself is not important for correct operations of the instrument as all power supplies are derived from DC-DC converters that are specified down to 8v.

Of chief importance is the state of charge of the batteries. At room temperature, 13V would indicate 100% available, and 12V 20% available. It is therefore possible to calculate how much battery power has been used during periods of no charge and compare this with the calculated usage. During 2006 (and 2005) with 1s sampling and a 10minute GPS fix every 4 hours the calculated power consumption is 458mW. The ratio of calculated use to measured use is presented in table 5.

| LPM | Use Ratio | Use calc@ sample rate | Min Volts | mid V | mid T | Notes |
|---------|-----------|-----------------------|-----------|-------|-------|-------|
| M78-337 | | | | | | 2,3 |
| M79-336 | | | | | | 2,3 |
| M81-388 | | | | | | 2,3 |
| M82-003 | | | | | | 2 |
| M83-347 | 1.08 | 1s | 11.73 | 11.95 | -47.0 | |
| M84-336 | 1.32 | 1s | 11.74 | * | * | 1 |
| M85-002 | | | | | | 2 |
| M85-096 | | | | | | 2 |
| M87-028 | | | | | | 2 |
| M87-069 | | | | | | 2 |
| M88-316 | | | | | | 2 |

Table 5a. Battery data in **2006**

Note 1. Wind generator coverage makes * invalid.

Note 2, Not enough data to report.

Note 3, Cellyte rather than Sunlyte batteries.

| LPM | Use Ratio | Use calc@ sample rate | Min Volts | mid V | mid T | Notes |
|---------|-----------|-----------------------|-----------|-------|-------|-------|
| M78-337 | 0.91 | 1s | 12.22 | * | * | 1,2,3 |
| M79-336 | 0.71 | 1s | 12.15 | * | * | 1,2,3 |
| M81-388 | * | * | 12.40 | * | * | 1,3 |
| M82-003 | 1.06 | 1s | 11.52 | 11.74 | -48.0 | |
| M83-347 | 1.32 | 1s | 11.78 | 11.89 | -48.0 | |
| M84-336 | * | * | 11.77 | * | * | 1 |
| M85-002 | 0.85 | 1s | 11.33 | 11.66 | -54.4 | |
| M85-096 | 1.04 | 1s | 11.50 | 11.67 | -57.8 | |
| M87-028 | N/A | N/A | N/A | N/A | N/A | 4 |
| M87-069 | 1.04 | 1s | 11.50 | 11.76 | -54.8 | |
| M88-316 | 1.08 | 1s | 11.68 | 11.80 | -50.9 | |

Table 5b. Battery data in **2005**

Note 1. Wind generator coverage makes * invalid.

Note 2, Usage calculation during pause in wind generation

Note 3, Cellyte rather than Sunlyte batteries.

Note 4, Short period of operation.

| LPM | Use Ratio | Use calc@ sample rate | Min Volts | mid V | mid T | Notes |
|---------|-----------|-----------------------|-----------|-------|-------|-------|
| M68-292 | 0.13 | 10s | 11.91 | | | |
| M78-337 | 0.85 | 1 | 12.11 | 12.36 | -34.3 | 3 |
| M79-336 | 0.80 | 1 | 11.99 | 12.29 | -32.9 | 3 |
| M81-388 | 0.68 | 1 | 11.95 | 12.29 | -35.8 | 3 |
| M82-003 | 0.94 | 1 | 11.68 | 11.86 | -49.5 | |
| M83-347 | * | * | 11.86 | * | * | 1 |
| M84-336 | * | * | 11.88 | * | * | 1 |
| M85-002 | 0.68 | 1 | 11.43 | 11.72 | -56.3 | 2 |
| M85-096 | 0.73 | 1 | 11.60 | 11.68 | -62.2 | 2 |
| M87-028 | 1.23 | 1 | 11.64 | 11.76 | -61.2 | 2 |
| M87-069 | 0.93 | 1 | 11.58 | 11.68 | -65.6 | 2 |
| M88-316 | 1.04 | 1 | 11.76 | 11.86 | -56.3 | 2 |

Table 5c. Battery data in **2004**

Note 1. Wind generator coverage makes * invalid.

Note 2, Usage calculation during pause in wind generation

Note 3, Cellyte rather than Sunlyte batteries.

| LPM | Use Ratio | Use calc@ sample rate | Min Volts | mid V | mid T | Notes |
|---------|-----------|-----------------------|-----------|-------|-------|-------|
| M78-337 | 0.56 | 1 | 12.09 | 12.34 | -34.3 | 3 |
| M79-336 | 0.62 | 1 | 12.03 | 12.25 | -33.8 | 3 |
| M81-388 | 0.62 | 1 | 12.01 | 12.27 | -36.3 | 3 |
| M82-003 | 1.13 | 1 | 11.52 | 11.64 | -49.5 | |
| M83-348 | * | * | 11.97 | * | * | 1 |
| M84-336 | * | * | 12.36 | * | * | 1 |
| M85-002 | 1.01 | 1 | 11.45 | 11.54 | -57.8 | 2 |
| M85-096 | 1.51 | 1 | 11.25 | 11.39 | -64.6 | 2 |
| M87-028 | 1.69 | 1 | 11.48 | 11.60 | -56.3 | 2 |
| M87-069 | 1.93 | 1 | 11.36 | 11.48 | -60.7 | 2 |
| M88-316 | 1.23 | 1 | 11.64 | 11.76 | -55.3 | 2 |

Table 5d. Battery data in **2003**

Note 1. Wind generator coverage makes * invalid.

Note 2, Usage calculation during pause in wind generation

Note 3, Cellyte rather than Sunlyte batteries.

| LPM | Use Ratio | Use calc@ sample rate | Min Volts | mid V | mid T | Notes |
|---------|-----------|-----------------------|-----------|-------|-------|-------|
| M78-337 | 1.02 | 1 | 12.13 | 12.40 | -32.9 | 3 |
| M79-336 | 0.97 | 1 | 12.13 | 12.48 | -31.4 | 3 |
| M81-388 | 1.13 | 1 | 12.13 | 12.25 | -34.8 | 3 |
| M82-003 | 0.41 | 3 | 11.98 | 11.99 | -43.1 | 1 |
| M83-348 | 0.54 | 3 | 11.91 | 12.03 | -42.1 | |
| M84-336 | 1.05 | 3 | 11.91 | 12.05 | -42.1 | |
| M85-002 | | | 12.13 | | | 1 |
| M85-096 | 0.50 | 3 | 11.64 | 11.91 | -58 | 2 |
| M87-028 | 0.40 | 3 | 11.86 | 11.95 | -50 | 2 |
| M87-069 | 1.12 | 60 | 11.74 | 11.91 | -47 | 2 |
| M88-316 | | | | | | 1 |

Table 5e. Battery data in **2002**

Note 1, Not a whole year.

Note 2, Mid T is Logger Temperature

Note 3, Cellyte rather than Sunlyte batteries.

The use ratio (calculated use/measured use) has to be interpreted with some caution, the batteries' voltage changes are actually quite small and this figure cannot be considered accurate. However tentative conclusions can be drawn by looking at the long term averages, although not enough data has been added in 2006 to significantly change the averages.

1. The long term average use ratio of the Sunlyte batteries is 1.02 – which indicates that we get close to the rated AHrs from the batteries. The very low discharge currents compensating for the low temperatures. The long term average use ratio for the Cellytes is 0.81 – this may indicate that they have poorer performance.

2. This years average use ratio of the Sunlytes is 1.20 but this doesn't mean much from just two sites.

| Battery type | To 2003 | 2004 | 2005 | 2006 |
|--------------|---------|------|------|-------------------|
| Cellytes | 0.82 | 0.78 | 0.81 | No data |
| Sunlytes | 1.04 | 0.93 | 1.07 | 1.20 ¹ |

Table 6. Average use ratio of the battery types.

Note 1. Just 2 sites.

4.3 Wind generators.

The wind generators fitted in the 2002/3 season were rated to -40°C , and did not spin continuously at the cold sites. Whether a wind generator spins or not is a function of both the windspeed (which we don't have a record of) and temperature, but in general the -40°C rated generators seemed to work down to about -50°C . In the 2004/5 season Wind generators with -60°C rated were deployed at the colder sites (see table 7), but there is little evidence that the -60°C generators work any better in the extreme temperatures than the -40°C rated units.

| Site | 2003 | 2004 | 2005 | 2006 |
|-----------|-------------|-------------|-------------|-------------|
| M68-292 | Not fitted | Not fitted | Not fitted | Not fitted |
| M78-337 | Not fitted | Not fitted | WG12/04-40C | WG12/04-40C |
| M79-336 | Not fitted | Not fitted | WG13/04-40C | WG13/04-40C |
| M81-388 | Not fitted | Not fitted | WG20/04-40C | WG20/04-40C |
| M82-003 | Not fitted | Not fitted | WG19/04-60C | WG19/04-60C |
| M83-347/8 | WG07/02-40C | WG07/02-40C | WG15/04-60C | WG15/04-60C |
| M84-336 | WG??/02-40C | WG??/02-40C | WG21/04-60C | WG21/04-60C |
| M85-002 | WG??/02-40C | WG??/02-40C | WG17/04-60C | WG17/04-60C |
| M85-096 | WG02/02-40C | WG02/02-40C | WG18/04-60C | WG18/04-60C |
| M87-028 | WG04/02-40C | WG04/02-40C | WG14/04-60C | WG14/04-60C |
| M87-069 | WG03/02-40C | WG03/02-40C | WG24/04-60C | WG24/04-60C |
| M88-316 | WG01/02-40C | WG01/02-40C | WG16/04-60C | WG16/04-60C |

Table 7: Wind generators at each site.

It is possible to estimate what the wind generator is delivering when it is operating by examining the way battery voltage recovers after a period of non-operation. Although not much data has been added in 2006 – table 8 summarises wind generator performance and gives an estimate of the power from the wind generator (when spinning).

| LPM | Rating of wind generator | Winter Performance | Wind Operating temperatures | Estimated Average Power from Wind | Notes |
|---------|--------------------------|--------------------|-----------------------------|-----------------------------------|-------|
| M78-337 | | | | | 1 |
| M79-336 | | | | | 1 |
| M81-388 | | | | | 1 |
| M82-003 | -60C | | | | 1 |
| M83-347 | -60C | reasonable early | >-50°C | 0.90W | |
| M84-336 | -60C | reasonable | >-55°C | 0.46W | |
| M85-002 | | | | | 1 |
| M85-096 | | | | | 1 |
| M87-028 | | | | | 1 |
| M87-069 | | | | | 1 |
| M88-316 | | | | | 1 |

Table 8a. Wind generator performance in **2006**.

None < practically none < some < reasonable < lots

Note 1, Not enough data.

| LPM | Rating of wind generator | Winter Performance | Wind Operating temperatures | Estimated Average Power from Wind | Notes |
|---------|--------------------------|--------------------|-----------------------------|-----------------------------------|-------|
| M78-337 | -40C | Some | >-40°C | 0.83W | |
| M79-336 | -40C | Some | >-35°C | 1.23W | |
| M81-388 | -40C | Reasonable | >-50°C | * | 1 |
| M82-003 | -60C | None | >-40°C | * | 1 |
| M83-347 | -60C | Some early | >-55°C | * | 1 |
| M84-336 | -60C | Lots | >-60°C | * | 1 |
| M85-002 | -60C | None | >-45°C | * | 1 |
| M85-096 | -60C | Practically None | >-55°C | * | 1 |
| M87-028 | -60C | N/A | N/A | N/A | 2 |
| M87-069 | -60C | None | >-45°C | * | 1 |
| M88-316 | -60C | None | >-45°C | * | 1 |

Table 8b. Wind generator performance in 2005.

None < practically none < some < reasonable < lots

Note 1, Wind generator coverage (high or low) makes * invalid.

Note 2, Short period of operation.

5.0 Site work performed the in 2006/7 season.

1. All podules replaced as normal
2. Magnetometer sensor cable replaced on M67-292 (Rothera system).

6.0 Summary of work planned for 2007/8 season and 2008.

1. Raise M78-337, M85-096 and M87-069 and opportunistically raise M79-336.
2. Examine output from logger L24/01 (used at M85/096 in 2007) for re-occurrence of faulty X channel seen in 2005, any indications should precipitate the changing of the analogue card.
3. Examine 2007 data for M67-292 to see if replacement sensor cable has fixed the problem.
4. The intention is to put a meteorological grade temperature sensor on M85-096 and M87-069 in the 2008/9 season
5. System M83-347 has a non-working 1m temperature measurement this was also apparent in the 2005 data so the sensor needs replacing.
6. System M87-068 has a non working temperature sensor in the outer enclosure – this was also apparent in the 2005 data, it should be possible to fix on site but at low priority.

APPENDIX 1

LPM Positions

BAS Low Power Magnetometer Positions

| Site | Name | 1 st Deployed | Latitude | Longitude | Elevation ft | IGRF Declination | IGRF H in nT | IGRF Z in nT |
|----------------------|--------------------|--------------------------|------------|------------|--------------|------------------|--------------|--------------|
| M68/292 | Nursie (Rothera) | 18/03/03 | 67°34'11"S | 68°07'00"W | 50 | +20°46' | 21396 | 36279 |
| M78/337 | Dr Leech | 04/01/01 | 77°30'40"S | 23°25'31"W | 5200 | -3°12' | 19590 | 40978 |
| M79/336 | Bob | 03/02/00 | 79°04'36"S | 24°07'11"W | 4000 | -2°34' | 19490 | 42566 |
| M81/338 | Edmund | 07/01/01 | 80°53'18"S | 22°15'50"W | 3860 | -3°59' | 19251 | 44348 |
| M82/003 | Mrs Miggins | 21/01/01 | 81°29'33"S | 02°58'23"E | 7900 | -24°21' | 18974 | 45079 |
| M83/348 | Baldrick | 23/01/01- 16/01/05 | 82°53'57"S | 12°14'39"W | 6900 | -12°21' | 18837 | 49960 |
| M83/347 ¹ | Baldrick | 16/01/05 | 82°46'30"S | 13°03'07"W | 6900 | -12°21' | 18837 | 49960 |
| M84/346 | Baron Richthoven | 15/01/01 | 84°21'14"S | 23°51'30"W | 6700 | -2°58' | 18519 | 47860 |
| M85/002 | Lord Melchett | 23/01/01 | 85°21'26"S | 02°03'47"E | 8800 | -25°57' | 18139 | 48909 |
| M85/096 | Baby Eating Bishop | 22/01/02 | 85°21'23"S | 95°58'32"E | 10500 | -118°12' | 15752 | 54672 |
| M87/028 | Flash Heart | 19/01/02 | 86°59'58"S | 28°24'37"E | 9330 | -51°09' | 17495 | 50792 |
| M87/068 | Speckled Jim | 22/01/02 | 86°30'53"S | 68°10'19"E | 10650 | -90°51' | 16678 | 52773 |
| M88/316 | Lord Whiteadder | 19/01/02 | 88°01'30"S | 43°52'02"W | 8370 | +16°08' | 17276 | 51644 |

Positions are from a single GPS fix from the logger in Jan 2003.
 Note 1. M843/348 was removed on 16/1/05 and replaced with M83/347
 Elevations are those given by the airunit (estimated for Rothera).
 IGRF values are those quoted 31/01/2000.
 Rothera is included from the date it became a standard LPM.

AFI/BAS Low Power Magnetometer Sites

These are 0.1nT/5s variants of the normal LPMs.

| Site | Name | 1 st Deployed | Latitude | Longitude | Elevation ft | IGRF Declination | IGRF H in nT | IGRF Z in nT |
|--------------|---------|--------------------------|------------|------------|--------------|------------------|--------------|--------------|
| Lockroy | Percy | 29/11/00 | 64°49'28"S | 63°29'20"W | 10 | +16°08' | 21223 | 33010 |
| Trump Island | Queenie | 01/12/00 | 66°01'57"S | 65°58'12"W | 10 | +18°27' | 21366 | 34544 |
| Rothera | Nursie | 12/12/00 | 67°29'18"S | 68°09'47"W | 50 | +20°46' | 21396 | 36279 |

Positions are those given by the deployment teams.
 Elevations are estimated.
 IGRF values are those quoted 31/01/2000.

JAPANESE NIPR/BAS Low Power Magnetometer Sites

| Site | Name | 1 st Deployed | Latitude | Longitude | Elevation ft | IGRF Declination | IGRF H in nT | IGRF Z in nT |
|---------|---------|--------------------------|------------|------------|--------------|------------------|--------------|--------------|
| J70/039 | Skallen | 15/01/03 | 69°40'23"S | 39°24'06"E | 30 | -48°41" | 19206 | 39127 |
| J68/041 | Omega | 31/01/03 | 68°34'39"S | 41°04'53"E | 140 | -49°39" | 19171 | 38842 |
| J69/041 | H100 | 01/01/03 | 69°17'44"S | 41°19'15"E | 4260 | -50°05" | 19198 | 39375 |
| J77/035 | DomeF | 06/02/03 | 77°19'02"S | 39°42'33"E | 12340 | -52°48" | 18969 | 44686 |

Positions are from a single GPS fix from the logger in Jan/Feb 2003.

Elevations are estimated from a single GPS fix from the logger in Jan/Feb 2003.

IGRF values are those quoted 01/02/2003.

BAS Low Power Radiometer Sites

| Site | Site Name | Equipment Name | 1 st Deployed | Latitude | Longitude | Elevation ft | IGRF Declination |
|---------|--------------|-----------------|--------------------------|-------------|------------|--------------|------------------|
| R71/292 | Fossil Bluff | Sergeant Wilson | 02 | 71°20 S | 68°17 W | 320 | +28° |
| R75/289 | Sky-Blu | Private Pike | 03 | 74°58 S | 70°46 W | 4500 | +23° |
| R81/338 | A80 | Private Frazer | 03 | 80°53'30" S | 22°14'48"W | 3800 | -4° |
| R84/336 | A84 | Corporal Jones | 03 | 84°21'34" S | 23°51'06"W | 6700 | -3° |

Positions and elevations are estimated.
IGRF value 2000-2003 epoch.

Mike Rose, 2/03/2005

APPENDIX 2

Document History

V1.0 4/12/07 1st Public version