METER ERROR REPORT

FINAL

Reconcile?	Y

Safety Issue?	Y/N

Thesis Report No.	

1. EXECUTIVE SUMMARY

SITE NAME	Evesham
LDZ	SW
START DATE (actual)	
LAST GOOD DATE	30th July 2012
END DATE	23rd July 2013
SIZE OF ERROR (No reconciliation required if under 0.1%)	2.6633% under-registration (12.04 GWh)
ESTIMATE – Y/N?	
ROOT CAUSE	Failed validation checks for pressure transmitter, pressure ADC and temperature ADC on both streams.
ANALYSIS	Recalculation of volumes using corrected pressure and temperature
METER TYPE	Turbine
AUTHOR	H. Colbourne
CHECKED BY	S. Kimpton

ACCEPTED BY WWU NETWORK		
RECONCILIATION	Distribution	Transportation

2. BACKGROUND

Evesham has two turbine meter streams using a gas chromatograph for CV determination and PTZ correction.

During the annual validation the CP4a (ADC Pressure Check) and the CP4e (ADC Temperature Check) tests failed on 22nd July 2013 for both streams; all transmitters subsequently passed following re-calibration. The CP10 (Pressure Transmitter Check) test failed on 23rd July 2013 for both streams and both transmitters subsequently passed following re-calibration.

On 28th January 2012 the turbine meter on stream B was replaced with a spool piece, whilst waiting for the meter to be replaced. Only Stream A was in use from this date until the end of the error.

3. ERROR QUANTIFICATION AND IMPACT

The pressure measurements were corrected for 'As Found' errors shown in Table 1, 2 and 3 for Stream A and Table 4, 5 and 6 for Stream B when the recorded measurement was in the appropriate range. Table 1 and 4 include the ADC errors only; Table 2 and 5 include the combined ADC and transmitter errors; Table 3 and 6 include the transmitter errors only.

The temperature measurements were corrected for the 'As Found' errors shown in Table 7 and 8 for Stream A and B respectively when the recorded measurement was in the appropriate range.

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	n/a	-0.5950	-0.5950
20.011	n/a	-1.2100	-1.2100
40.022	n/a	-1.8300	-1.8300
60.033	n/a	-2.4450	-2.4450
80.044	n/a	-3.0650	-3.0650

Table 1 – Pressure Errors, Stream A (31/07/12 – 01/08/12)

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	0.01565	-0.5950	-0.57935
20.011	0.2926	-1.2100	-0.9174
40.022	0.30075	-1.8300	-1.52925
60.033	0.83705	-2.4450	-1.60795
80.044	1.0546	-3.0650	-2.0104

Table 2 – Pressure Errors, Stream A (01/08/12 – 22/07/13)

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	0.01565	n/a	0.01565
20.011	0.2926	n/a	0.2926
40.022	0.30075	n/a	0.30075
60.033	0.83705	n/a	0.83705
80.044	1.0546	n/a	1.0546

Table 3 – Pressure Errors, Stream A (22/07/13 – 23/07/13)

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	n/a	0.4113	0.4113
20.011	n/a	-0.8038	-0.8038
40.022	n/a	-1.2088	-1.2088
60.033	n/a	-1.6138	-1.6138
80.044	n/a	-2.0188	-2.0188

Table 4 – Pressure Errors, Stream B (31/07/12 – 01/08/12)

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	-0.0094	0.4113	0.4019
20.011	-0.1668	-0.8038	-0.9706
40.022	-0.24615	-1.2088	-1.45495
60.033	-0.3567	-1.6138	-1.9705
80.044	-0.4079	-2.0188	-2.4267

Table 5 – Pressure Errors, Stream B (01/08/12 – 22/07/13)

Pressure (barg)	CP10 Error (% span)	CP4a Error (% span)	Combined Error (% span)
0	-0.0094	n/a	-0.0094
20.011	-0.1668	n/a	-0.1668
40.022	-0.24615	n/a	-0.24615
60.033	-0.3567	n/a	-0.3567
80.044	-0.4079	n/a	-0.4079

Table 6 – Pressure Errors, Stream B (22/07/13 – 23/07/13)

Temperature (°C)	CP12 Error (% span)	CP4e Error (% span)	Combined Error (% span)
-10	0.16875	-1.2400	-1.07125
2.5	0.1469	-2.5000	-2.3531
15	-0.075	-3.7400	-3.815
27.5	-0.10005	-4.9800	-5.08005
40	-0.0813	-4.2400	-4.3213

Table 7 – Temperature Errors, Stream A (31/07/12 – 22/07/13)

Temperature (°C)	CP12 Error (% span)	CP4e Error (% span)	Combined Error (% span)
-10	0.14065	0.0000	0.14065
2.5	0.1	-0.0200	0.08
15	-0.1063	-0.0200	-0.1263
27.5	-0.1313	-0.0200	-0.1513
40	-0.1125	-0.0400	-0.1525

Table 8 – Temperature Errors, Stream B (31/07/12 – 22/07/13)

Note: The CP10 and CP12 errors are the average of the rising and falling errors.

The density, flow rate and daily volumes were recalculated from the corrected pressure and temperature readings. The error was calculated on a daily basis as the difference between volume totals using measured and corrected inputs.

The overall error is an under-registration of 2.6633%. The error is equivalent to 12.04 GWh.

4. CAUSES

Pressure ADC checks, temperature ADC check and pressure transmitter checks failed during routine validation for both streams.

5. RECOMMENDATIONS AND LEARNING

Failures of this type will occur occasionally, if the same checks fail regularly then it suggests a fundamental problem with the equipment being tested and repairs or replacements should be made.

The start of the error cannot be identified therefore the total error to be reconciled should be halved in accordance with the Offtake Arrangements

Document. Appendix A shows the daily correction factors, which have already been halved.

On 2nd August 2012, 9th August 2012, 10th August 2012 and 18th July 2013 a small discrepancy was found between the RBD and the Gemini data (during ME2 checks). A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

On 2nd November 2012, 3rd November 2012, 4th November 2012, 14th December 2012, 15th December 2012 and 22nd January 2013 a small discrepancy was found between the RBD and the Gemini data (for more details see references, Evesham Summary). A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

REFERENCES

HPMIS Database

Evesham_Data_1.xlsx – calculation spreadsheet

Evesham_Data_2.xlsx – calculation spreadsheet

Evesham_Summary.xlsx – results spreadsheet

VERSION HISTORY

Version	Changes	Author	Date
O	Original	H. Colbourne	27/03/2014
1	Report number SW031 added. LDZ changed to SW.	H. Colbourne	30/04/2014

DISTRIBUTION

Wales and West Utilities

APPENDIX A – Daily Correction Factors

The table below gives the daily correction factors which should be used to reconcile the error.

*On 2nd August 2012, 9th August 2012, 10th August 2012 and 18th July 2013 a small discrepancy was found between the RBD and the Gemini data (during ME2 checks). A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

**On 2nd November 2012, 3rd November 2012, 4th November 2012, 14th December 2012, 15th December 2012 and 22nd January 2013 a small discrepancy was found between the RBD and the Gemini data. A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
28/07/2012	1.000000	25/08/2012	1.016086
29/07/2012	1.000000	26/08/2012	1.016081
30/07/2012	1.000000	27/08/2012	1.016109
31/07/2012	1.008934	28/08/2012	1.016088
01/08/2012	1.015191	29/08/2012	1.016107
02/08/2012	***1.013735**	30/08/2012	1.016021
03/08/2012	1.014859	31/08/2012	1.016107
04/08/2012	1.015956	01/09/2012	1.016065
05/08/2012	1.015962	02/09/2012	1.016085
06/08/2012	1.015960	03/09/2012	1.016082
07/08/2012	1.015965	04/09/2012	1.016074
08/08/2012	1.015995	05/09/2012	1.016103
09/08/2012	***1.015977**	06/09/2012	1.016082
10/08/2012	***1.015977**	07/09/2012	1.016057
11/08/2012	1.015947	08/09/2012	1.016073
12/08/2012	1.015999	09/09/2012	1.016123
13/08/2012	1.016072	10/09/2012	1.016119
14/08/2012	1.016070	11/09/2012	1.016090
15/08/2012	1.016102	12/09/2012	1.016091
16/08/2012	1.016070	13/09/2012	1.016072
17/08/2012	1.016081	14/09/2012	1.016080
18/08/2012	1.016083	15/09/2012	1.016072
19/08/2012	1.016081	16/09/2012	1.016081
20/08/2012	1.016088	17/09/2012	1.016114
21/08/2012	1.016098	18/09/2012	1.016101
22/08/2012	1.016111	19/09/2012	1.016144
23/08/2012	1.016106	20/09/2012	1.016133
24/08/2012	1.016090	21/09/2012	1.016135

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
22/09/2012	1.016124	07/11/2012	1.016213
23/09/2012	1.016172	08/11/2012	1.016200
24/09/2012	1.016166	09/11/2012	1.016195
25/09/2012	1.016187	10/11/2012	1.016198
26/09/2012	1.016150	11/11/2012	1.016204
27/09/2012	1.016126	12/11/2012	1.016192
28/09/2012	1.016145	13/11/2012	1.016189
29/09/2012	1.016149	14/11/2012	1.016133
30/09/2012	1.016144	15/11/2012	1.016210
01/10/2012	1.013376	16/11/2012	1.016209
02/10/2012	1.012394	17/11/2012	1.016208
03/10/2012	1.012387	18/11/2012	1.016201
04/10/2012	1.012389	19/11/2012	1.016156
05/10/2012	1.012397	20/11/2012	1.016144
06/10/2012	1.012387	21/11/2012	1.016172
07/10/2012	1.012406	22/11/2012	1.016207
08/10/2012	1.012400	23/11/2012	1.016209
09/10/2012	1.012388	24/11/2012	1.016213
10/10/2012	1.012386	25/11/2012	1.016214
11/10/2012	1.012409	26/11/2012	1.016217
12/10/2012	1.012415	27/11/2012	1.016359
13/10/2012	1.012393	28/11/2012	1.016214
14/10/2012	1.012411	29/11/2012	1.016174
15/10/2012	1.012397	30/11/2012	1.016172
16/10/2012	1.012402	01/12/2012	1.016310
17/10/2012	1.012408	02/12/2012	1.016175
18/10/2012	1.012380	03/12/2012	1.016166
19/10/2012	1.012374	04/12/2012	1.016169
20/10/2012	1.012369	05/12/2012	1.016174
21/10/2012	1.012387	06/12/2012	1.016171
22/10/2012	1.012388	07/12/2012	1.016165
23/10/2012	1.012446	08/12/2012	1.016151
24/10/2012	1.012168	09/12/2012	1.016139
25/10/2012	1.012360	10/12/2012	1.016173
26/10/2012	1.012449	11/12/2012	1.016211
27/10/2012	1.012475	12/12/2012	1.016183
28/10/2012	1.012463	13/12/2012	1.016213
29/10/2012	1.012449	**14/12/2012**	****1.016163**
30/10/2012	1.012485	**15/12/2012**	****1.016163**
31/10/2012	1.012461	16/12/2012	1.016127
01/11/2012	1.012494	17/12/2012	1.016130
02/11/2012	****1.013238**	18/12/2012	1.016139
03/11/2012	****1.013238**	19/12/2012	1.016147
04/11/2012	****1.013238**	20/12/2012	1.016126
05/11/2012	1.012543	21/12/2012	1.016130
06/11/2012	1.015456	22/12/2012	1.016123

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
23/12/2012	1.016115	07/02/2013	1.012441
24/12/2012	1.016119	08/02/2013	1.012403
25/12/2012	1.016114	09/02/2013	1.012426
26/12/2012	1.016131	10/02/2013	1.012447
27/12/2012	1.016144	11/02/2013	1.012448
28/12/2012	1.016141	12/02/2013	1.012438
29/12/2012	1.016125	13/02/2013	1.012445
30/12/2012	1.016140	14/02/2013	1.012430
31/12/2012	1.016135	15/02/2013	1.012405
01/01/2013	1.016145	16/02/2013	1.012395
02/01/2013	1.016157	17/02/2013	1.012407
03/01/2013	1.016213	18/02/2013	1.012412
04/01/2013	1.016172	19/02/2013	1.012408
05/01/2013	1.016189	20/02/2013	1.012433
06/01/2013	1.016191	21/02/2013	1.012458
07/01/2013	1.016201	22/02/2013	1.012451
08/01/2013	1.016197	23/02/2013	1.012460
09/01/2013	1.016215	24/02/2013	1.012474
10/01/2013	1.016213	25/02/2013	1.012435
11/01/2013	1.016216	26/02/2013	1.012452
12/01/2013	1.016230	27/02/2013	1.012431
13/01/2013	1.016234	28/02/2013	1.012412
14/01/2013	1.016223	01/03/2013	1.012403
15/01/2013	1.016249	02/03/2013	1.012418
16/01/2013	1.016260	03/03/2013	1.012430
17/01/2013	1.016256	04/03/2013	1.012438
18/01/2013	1.016248	05/03/2013	1.012446
19/01/2013	1.016213	06/03/2013	1.012403
20/01/2013	1.016187	07/03/2013	1.012425
21/01/2013	1.016219	08/03/2013	1.012402
22/01/2013	****1.014353**	09/03/2013	1.012419
23/01/2013	1.012499	10/03/2013	1.012458
24/01/2013	1.012509	11/03/2013	1.012487
25/01/2013	1.012492	12/03/2013	1.012471
26/01/2013	1.012436	13/03/2013	1.012465
27/01/2013	1.012435	14/03/2013	1.012441
28/01/2013	1.012441	15/03/2013	1.012447
29/01/2013	1.012388	16/03/2013	1.012378
30/01/2013	1.012405	17/03/2013	1.012389
31/01/2013	1.012403	18/03/2013	1.012429
01/02/2013	1.012390	19/03/2013	1.012443
02/02/2013	1.012413	20/03/2013	1.012458
03/02/2013	1.012424	21/03/2013	1.012449
04/02/2013	1.012412	22/03/2013	1.012464
05/02/2013	1.012428	23/03/2013	1.012478
06/02/2013	1.012431	24/03/2013	1.012494

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
25/03/2013	1.012492	10/05/2013	1.012402
26/03/2013	1.012490	11/05/2013	1.012422
27/03/2013	1.012480	12/05/2013	1.012414
28/03/2013	1.012471	13/05/2013	1.012410
29/03/2013	1.012415	14/05/2013	1.012413
30/03/2013	1.012436	15/05/2013	1.012355
31/03/2013	1.012447	16/05/2013	1.012311
01/04/2013	1.012447	17/05/2013	1.012311
02/04/2013	1.012404	18/05/2013	1.012307
03/04/2013	1.012459	19/05/2013	1.012371
04/04/2013	1.012478	20/05/2013	1.012293
05/04/2013	1.012459	21/05/2013	1.012342
06/04/2013	1.012419	22/05/2013	1.012281
07/04/2013	1.012383	23/05/2013	1.012295
08/04/2013	1.012392	24/05/2013	1.012302
09/04/2013	1.012407	25/05/2013	1.012292
10/04/2013	1.012414	26/05/2013	1.012259
11/04/2013	1.012424	27/05/2013	1.012265
12/04/2013	1.012379	28/05/2013	1.012282
13/04/2013	1.012380	29/05/2013	1.012267
14/04/2013	1.012367	30/05/2013	1.012280
15/04/2013	1.012345	31/05/2013	1.012244
16/04/2013	1.012351	01/06/2013	1.012247
17/04/2013	1.012361	02/06/2013	1.012268
18/04/2013	1.012379	03/06/2013	1.012278
19/04/2013	1.012383	04/06/2013	1.012264
20/04/2013	1.012409	05/06/2013	1.012255
21/04/2013	1.012378	06/06/2013	1.012252
22/04/2013	1.012373	07/06/2013	1.012256
23/04/2013	1.012367	08/06/2013	1.012256
24/04/2013	1.012338	09/06/2013	1.012249
25/04/2013	1.012371	10/06/2013	1.012276
26/04/2013	1.012372	11/06/2013	1.012287
27/04/2013	1.012380	12/06/2013	1.012281
28/04/2013	1.012373	13/06/2013	1.012262
29/04/2013	1.012378	14/06/2013	1.012255
30/04/2013	1.012366	15/06/2013	1.012248
01/05/2013	1.012356	16/06/2013	1.012251
02/05/2013	1.012410	17/06/2013	1.012242
03/05/2013	1.012339	18/06/2013	1.012258
04/05/2013	1.012374	19/06/2013	1.012258
05/05/2013	1.012346	20/06/2013	1.012271
06/05/2013	1.012364	21/06/2013	1.012263
07/05/2013	1.012370	22/06/2013	1.012271
08/05/2013	1.012385	23/06/2013	1.012264
09/05/2013	1.012425	24/06/2013	1.012253

Gas Day	Daily Correction Factor
25/06/2013	1.012266
26/06/2013	1.012283
27/06/2013	1.012284
28/06/2013	1.012278
29/06/2013	1.012271
30/06/2013	1.012282
01/07/2013	1.012249
02/07/2013	1.012239
03/07/2013	1.012224
04/07/2013	1.012251
05/07/2013	1.012246
06/07/2013	1.012250
07/07/2013	1.012252
08/07/2013	1.012256
09/07/2013	1.012244
10/07/2013	1.012267
11/07/2013	1.012252
12/07/2013	1.012267
13/07/2013	1.012295
14/07/2013	1.012291
15/07/2013	1.012286
16/07/2013	1.012299
17/07/2013	1.012047
18/07/2013	***1.012063**
19/07/2013	1.011937
20/07/2013	1.011968
21/07/2013	1.011951
22/07/2013	1.002681
23/07/2013	0.998970
24/07/2013	1.000000
25/07/2013	1.000000
26/07/2013	1.000000