

METER ERROR REPORT**FINAL**

Reconcile?	Y
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Safety Issue?	N
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Thesis Report No.	
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1. EXECUTIVE SUMMARY

SITE NAME	Cowpen Bewley	
LDZ	NO	
START DATE (actual)	Unknown	
LAST GOOD DATE	3 rd March 2020	
END DATE	18 th August 2020	
SIZE OF ERROR (No reconciliation required if under 0.1%)	-0.25692% on original billed volume. -5.33 GWh	
ESTIMATE – Y/N?	N	
ROOT CAUSE	Possible ADC drift	
ANALYSIS	Recalculation of volume using adjusted values for flow pressure, LRDP, HRDP and temperature.	
METER TYPE	Orifice	
AUTHOR	Will van Woerden	
CHECKED BY	Piers Eldridge	
ACCEPTED BY NGN		
RECONCILIATION	Distribution	Transportation

The calculation for the total error is taken as the error in volume caused by the error in ADC conversion for flow pressure, HRDP, LRDP and temperature, divided by the total volume as measured by the station (calculated as the Cumulative Net Volume Total value at the end of the analysis period minus Cumulative Net Volume Total value at the start of the analysis period.

The percentage error in relation to original billed volume is -0.25692%.

2. BACKGROUND

Gas is supplied to part of the Northern Gas Networks network at Cowpen Bewley FWACV offtake. The site meter system comprises of single stream single orifice plate meter using a gas chromatograph for RD and CV determination and PTZ correction.

During a routine validation at the site between the dates of 24th to the 26th of August 2020, validation checks CP4A, CP4B, CP4C and CP5, (Corresponding to ADC Checks (4-20mA) for Flow Pressure, LRDP, HRDP and Temperature respectively) failed on first iteration. Adjustments were made and the check passed on second iteration. Check CP4D for Standby differential pressure also failed on first iteration, but this value is not included as it does not impact error analysis.

Figures 1, 2, 3 and 4 show respectively the result of the checks for flow pressure, LRDP, HRDP and temperature during the validation.

TEST RESULTS

Span 80.00 Barg

Span (%)	Applied Current (mA)	Expected Pressure (Barg)	Displayed Pressure (Barg)	Error (% Span)
0.0	4.000	0.0000	0.0530	0.0663
25.0	8.000	20.0000	20.1100	0.1375
50.0	12.000	40.0000	40.1660	0.2075
75.0	16.000	60.0000	60.2230	0.2787
100.0	20.000	80.0000	80.2800	0.3500

Status AF

Figure 1 Check CP4A for Flow Pressure Failure during ME/2

TEST RESULTS

Span 125.00 mBar

Span (%)	Applied Current (mA)	Expected DP (mBar)	Displayed DP (mBar)	Error (% Span)
0.0	4.000	0.0000	0.1075	0.0860
25.0	8.000	31.2500	31.4440	0.1552
50.0	12.000	62.5000	62.7886	0.2309
75.0	16.000	93.7500	94.1333	0.3066
100.0	20.000	125.0000	125.4616	0.3693

Status AF

Figure 2 Check CP4B for LRDP ADC Failure during ME/2

TEST RESULTS

Span 1000.00 mBar

Span (%)	Applied Current (mA)	Expected DP (mBar)	Displayed DP (mBar)	Error (% Span)
0.0	4.000	0.0000	0.7741	0.0774
25.0	8.000	250.0000	251.2643	0.1264
50.0	12.000	500.0000	501.8815	0.1882
75.0	16.000	750.0000	752.4988	0.2499
100.0	20.000	1000.0000	1003.0524	0.3052

Status AF

Figure 3 Check CP4C for HRDP ADC Failure during ME/2

TEST RESULTS

Range -10.0 To 40.0 °C

Span (%)	Applied Resistance (Ω)	Expected Temperature (°C)	Displayed Temperature (°C)	Error (°C)
0.0	96.09	-10.00	-9.53	0.47
25.0	100.98	2.50	3.27	0.77
50.0	105.85	15.00	15.79	0.79
75.0	110.70	27.50	28.34	0.84
100.0	115.54	40.00	40.89	0.89

Status AF

Figure 4 Check CP5 for Temperature (RTD) ADC Failure during ME/2

3. ERROR QUANTIFICATION AND IMPACT

Flow and conditions data were requested for the period since the previous validation which was completed on 2nd March 2020.

For each data cycle, occurring every 4 minutes, the flowrate has been recalculated using adjusted values for the pressure. Adjustments for the error in each case are made using a linear interpolation between known data points as determined from the errors found in the ME/2.

The difference between the uncorrected and corrected flowrates for the stream are added to the station flowrate. A correction factor is also calculated and applied to the difference between subsequent volumetric integrator readings to determine the volume error. Gas day correction factors are summarised in Table 1.

The data provided has been analysed and a start date of the error could not be determined from any step changes in the data. Therefore, the calculated error is halved and applied across the period in accordance with Offtakes Arrangements Document. Daily correction factors to apply this half error are calculated and included within the appendix.

4. CAUSES

The cause of the error is unknown but the analogue to digital conversion done by the OMNI flow computer type A I/O module is known to drift.

5. RECOMMENDATIONS AND LEARNING

ADC 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.

REFERENCES

1. Cowpen Bewley MER V1.0.xlsx

VERSION HISTORY

<i>Version</i>	<i>Changes</i>	<i>Author</i>	<i>Date</i>
1.0	<i>First issue</i>	<i>W. van Woerden</i>	<i>20.11.2020</i>

2.0	Correction of stated error.		05.01.2020
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APPENDIX

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

Table 1 Daily Correction Factors

Gas Day	Daily Volume (SCM)	Volume Error (SCM)	Volume Error (Halved) (SCM)	Daily Correction Factor (Full)	Daily Correction Factor (Halved)
03/03/2020	1630974	-5024.895091	-2512.447545	0.996919	0.998460
04/03/2020	1636818	-4745.94019	-2372.970095	0.997101	0.998550
05/03/2020	1625640	-4761.462243	-2380.731122	0.997071	0.998536
06/03/2020	1629784	-4805.469268	-2402.734634	0.997051	0.998526
07/03/2020	1404490	-5219.168485	-2609.584243	0.996284	0.998142
08/03/2020	1207847	-5483.067658	-2741.533829	0.995460	0.997730
09/03/2020	1477664	-5103.718896	-2551.859448	0.996546	0.998273
10/03/2020	1309007	-5214.426207	-2607.213103	0.996017	0.998008
11/03/2020	1450920	-4978.922226	-2489.461113	0.996568	0.998284
12/03/2020	1689017	-5050.802534	-2525.401267	0.997010	0.998505
13/03/2020	1810576	-4722.652742	-2361.326371	0.997392	0.998696
14/03/2020	1618222	-4759.582841	-2379.79142	0.997059	0.998529
15/03/2020	1481158	-4985.062855	-2492.531427	0.996634	0.998317
16/03/2020	1623197	-4717.744006	-2358.872003	0.997094	0.998547
17/03/2020	1437282	-4838.174175	-2419.087087	0.996634	0.998317
18/03/2020	1608479	-4753.722237	-2376.861118	0.997045	0.998522
19/03/2020	1512834	-4899.444217	-2449.722109	0.996761	0.998381
20/03/2020	1544430	-4912.483361	-2456.24168	0.996819	0.998410
21/03/2020	1521482	-4952.25255	-2476.126275	0.996745	0.998373
22/03/2020	1447126	-4986.593462	-2493.296731	0.996554	0.998277
23/03/2020	1603403	-4882.941949	-2441.470974	0.996955	0.998477
24/03/2020	1352898	-5389.213181	-2694.606591	0.996017	0.998008
25/03/2020	923223	-6424.032171	-3212.016086	0.993042	0.996521
26/03/2020	1021356	-5859.324065	-2929.662033	0.994263	0.997132
27/03/2020	1244594	-5415.066878	-2707.533439	0.995649	0.997825
28/03/2020	1351672	-4743.212697	-2371.606349	0.996491	0.998245
29/03/2020	1634026	-4915.621715	-2457.810858	0.996992	0.998496
30/03/2020	1378066	-4990.238338	-2495.119169	0.996379	0.998189
31/03/2020	1403210	-5165.373972	-2582.686986	0.996319	0.998159
01/04/2020	1337204	-5148.630461	-2574.315231	0.996150	0.998075
02/04/2020	1203964	-5234.595284	-2617.297642	0.995652	0.997826
03/04/2020	1317711	-5096.766808	-2548.383404	0.996132	0.998066

04/04/2020	1055129	-5615.407656	-2807.703828	0.994678	0.997339
05/04/2020	779470	-6670.528263	-3335.264132	0.991442	0.995721
06/04/2020	773449	-6748.837474	-3374.418737	0.991274	0.995637
07/04/2020	760513	-7002.256032	-3501.128016	0.990793	0.995396
08/04/2020	707858	-7077.987257	-3538.993629	0.990001	0.995000
09/04/2020	1047742	-5649.108517	-2824.554258	0.994608	0.997304
10/04/2020	803290	-6567.232157	-3283.616078	0.991825	0.995912
11/04/2020	573331	-8637.642337	-4318.821168	0.984934	0.992467
12/04/2020	817040	-6503.403032	-3251.701516	0.992040	0.996020
13/04/2020	1381948	-5119.602736	-2559.801368	0.996295	0.998148
14/04/2020	1029682	-5606.544518	-2803.272259	0.994555	0.997278
15/04/2020	661404	-7805.25155	-3902.625775	0.988199	0.994099
16/04/2020	731972	-6672.27559	-3336.137795	0.990885	0.995442
17/04/2020	915530	-5894.389886	-2947.194943	0.993562	0.996781
18/04/2020	897897	-6012.294913	-3006.147456	0.993304	0.996652
19/04/2020	740308	-6845.349341	-3422.67467	0.990753	0.995377
20/04/2020	822173	-6250.194783	-3125.097391	0.992398	0.996199
21/04/2020	792568	-6214.541221	-3107.27061	0.992159	0.996079
22/04/2020	773820	-6209.206271	-3104.603135	0.991976	0.995988
23/04/2020	822316	-6070.009099	-3035.004549	0.992618	0.996309
24/04/2020	774182	-6592.152875	-3296.076438	0.991485	0.995743
25/04/2020	787575	-6410.103716	-3205.051858	0.991861	0.995930
26/04/2020	812316	-6340.608432	-3170.304216	0.992194	0.996097
27/04/2020	844422	-5919.613821	-2959.806911	0.992990	0.996495
28/04/2020	1034840	-5408.993347	-2704.496673	0.994773	0.997387
29/04/2020	1158379	-5239.177604	-2619.588802	0.995477	0.997739
30/04/2020	979203	-5578.516244	-2789.258122	0.994303	0.997152
01/05/2020	969801	-5654.957686	-2827.478843	0.994169	0.997084
02/05/2020	834137	-6244.65801	-3122.329005	0.992514	0.996257
03/05/2020	872431	-6162.432767	-3081.216383	0.992936	0.996468
04/05/2020	870643	-5991.13474	-2995.56737	0.993119	0.996559
05/05/2020	905113	-5947.1974	-2973.5987	0.993429	0.996715
06/05/2020	841765	-6264.77257	-3132.386285	0.992558	0.996279
07/05/2020	693564	-7004.750105	-3502.375053	0.989900	0.994950
08/05/2020	548164	-8649.023312	-4324.511656	0.984222	0.992111
09/05/2020	601947	-7942.653855	-3971.326927	0.986805	0.993403
10/05/2020	1023798	-5548.621778	-2774.310889	0.994580	0.997290
11/05/2020	1249141	-5029.020382	-2514.510191	0.995974	0.997987
12/05/2020	1235733	-4818.923729	-2409.461865	0.996100	0.998050
13/05/2020	1179747	-4958.537718	-2479.268859	0.995797	0.997898
14/05/2020	966209	-5502.788112	-2751.394056	0.994305	0.997152
15/05/2020	828343	-6154.039699	-3077.019849	0.992571	0.996285
16/05/2020	751637	-6556.525829	-3278.262914	0.991277	0.995639
17/05/2020	751731	-6675.689448	-3337.844724	0.991120	0.995560
18/05/2020	738490	-6680.124141	-3340.062071	0.990954	0.995477
19/05/2020	652381	-7321.287899	-3660.643949	0.988778	0.994389
20/05/2020	420163	-11533.76037	-5766.880184	0.972549	0.986275

21/05/2020	405624	-10706.52991	-5353.264955	0.973605	0.986802
22/05/2020	546971	-8781.037382	-4390.518691	0.983946	0.991973
23/05/2020	787720	-6615.249646	-3307.624823	0.991602	0.995801
24/05/2020	741384	-6908.199485	-3454.099743	0.990682	0.995341
25/05/2020	662081	-7116.283157	-3558.141579	0.989252	0.994626
26/05/2020	646605	-7764.925815	-3882.462908	0.987991	0.993996
27/05/2020	684202	-7217.795956	-3608.897978	0.989451	0.994725
28/05/2020	663945	-7421.953391	-3710.976696	0.988821	0.994411
29/05/2020	585593	-8197.486598	-4098.743299	0.986001	0.993001
30/05/2020	596640	-8323.782487	-4161.891243	0.986049	0.993024
31/05/2020	598093	-8356.779637	-4178.389819	0.986028	0.993014
01/06/2020	690867	-7253.318171	-3626.659085	0.989501	0.994751
02/06/2020	647347	-7405.329531	-3702.664766	0.988560	0.994280
03/06/2020	1067587	-5580.341102	-2790.170551	0.994773	0.997386
04/06/2020	1235320	-4849.183884	-2424.591942	0.996075	0.998037
05/06/2020	1187713	-4883.357008	-2441.678504	0.995888	0.997944
06/06/2020	1211963	-4905.198871	-2452.599435	0.995953	0.997976
07/06/2020	1290436	-4788.334783	-2394.167392	0.996289	0.998145
08/06/2020	1220690	-4795.640158	-2397.820079	0.996071	0.998036
09/06/2020	1223989	-4884.367335	-2442.183668	0.996009	0.998005
10/06/2020	1503690	-4457.630823	-2228.815411	0.997036	0.998518
11/06/2020	1697757	-4330.087043	-2165.043522	0.997450	0.998725
12/06/2020	1695099	-4292.971215	-2146.485607	0.997467	0.998734
13/06/2020	1360538	-4511.714227	-2255.857114	0.996684	0.998342
14/06/2020	1353610	-4569.051642	-2284.525821	0.996625	0.998312
15/06/2020	1250502	-4714.325287	-2357.162643	0.996230	0.998115
16/06/2020	1317228	-4583.738738	-2291.869369	0.996520	0.998260
17/06/2020	1333451	-4632.547513	-2316.273756	0.996526	0.998263
18/06/2020	1416691	-4553.684773	-2276.842386	0.996786	0.998393
19/06/2020	1297766	-4628.801375	-2314.400688	0.996433	0.998217
20/06/2020	1097083	-5042.160037	-2521.080019	0.995404	0.997702
21/06/2020	1232302	-4726.989841	-2363.49492	0.996164	0.998082
22/06/2020	1268984	-4658.695564	-2329.347782	0.996329	0.998164
23/06/2020	1211960	-4763.747278	-2381.873639	0.996069	0.998035
24/06/2020	1215120	-4729.970969	-2364.985484	0.996107	0.998054
25/06/2020	1248464	-4673.846674	-2336.923337	0.996256	0.998128
26/06/2020	1182437	-4846.362611	-2423.181305	0.995901	0.997951
27/06/2020	1116061	-5002.921325	-2501.460662	0.995517	0.997759
28/06/2020	1039788	-5182.92647	-2591.463235	0.995015	0.997508
29/06/2020	1052868	-5195.499902	-2597.749951	0.995065	0.997533
30/06/2020	1026261	-5154.623527	-2577.311764	0.994977	0.997489
01/07/2020	1159055	-4877.780502	-2438.890251	0.995792	0.997896
02/07/2020	1167544	-4866.943508	-2433.471754	0.995831	0.997916
03/07/2020	1210236	-4812.464045	-2406.232023	0.996024	0.998012
04/07/2020	1065505	-5187.07361	-2593.536805	0.995132	0.997566
05/07/2020	1053626	-5294.056588	-2647.028294	0.994975	0.997488
06/07/2020	1166495	-4870.273032	-2435.136516	0.995825	0.997912

07/07/2020	1246912	-4736.679067	-2368.339533	0.996201	0.998101
08/07/2020	1283710	-4696.15487	-2348.077435	0.996342	0.998171
09/07/2020	1235487	-4755.588948	-2377.794474	0.996151	0.998075
10/07/2020	1189251	-4848.712442	-2424.356221	0.995923	0.997961
11/07/2020	1052588	-5180.366838	-2590.183419	0.995078	0.997539
12/07/2020	1003441	-5347.649029	-2673.824515	0.994671	0.997335
13/07/2020	1070399	-5194.147623	-2597.073811	0.995147	0.997574
14/07/2020	1116442	-5021.250284	-2510.625142	0.995502	0.997751
15/07/2020	1165960	-4918.71467	-2459.357335	0.995781	0.997891
16/07/2020	1062391	-5185.054152	-2592.527076	0.995119	0.997560
17/07/2020	1118297	-5040.376107	-2520.188054	0.995493	0.997746
18/07/2020	1014560	-5235.680077	-2617.840038	0.994839	0.997420
19/07/2020	1034672	-5174.231002	-2587.115501	0.994999	0.997500
20/07/2020	1146940	-4939.005424	-2469.502712	0.995694	0.997847
21/07/2020	1155895	-4849.569202	-2424.784601	0.995804	0.997902
22/07/2020	1189799	-4827.485291	-2413.742646	0.995943	0.997971
23/07/2020	1169494	-4860.312605	-2430.156303	0.995844	0.997922
24/07/2020	1027476	-5207.287107	-2603.643554	0.994932	0.997466
25/07/2020	961318	-5521.198708	-2760.599354	0.994257	0.997128
26/07/2020	982807	-5430.547394	-2715.273697	0.994474	0.997237
27/07/2020	1072388	-5099.39332	-2549.69666	0.995245	0.997622
28/07/2020	1062556	-5124.292075	-2562.146038	0.995177	0.997589
29/07/2020	1022010	-5210.168692	-2605.084346	0.994902	0.997451
30/07/2020	1046736	-5135.214345	-2567.607172	0.995094	0.997547
31/07/2020	993636	-5259.138034	-2629.569017	0.994707	0.997354
01/08/2020	1006675	-5253.992784	-2626.996392	0.994781	0.997390
02/08/2020	1052560	-5094.379361	-2547.18968	0.995160	0.997580
03/08/2020	1131156	-4880.299091	-2440.149545	0.995686	0.997843
04/08/2020	1290520	-4625.835357	-2312.917678	0.996416	0.998208
05/08/2020	1116343	-4971.810862	-2485.905431	0.995546	0.997773
06/08/2020	1098660	-4934.710661	-2467.35533	0.995508	0.997754
07/08/2020	1018064	-5200.87709	-2600.438545	0.994891	0.997446
08/08/2020	952878	-5393.138992	-2696.569496	0.994340	0.997170
09/08/2020	1015931	-5200.99775	-2600.498875	0.994881	0.997440
10/08/2020	1065682	-5113.736852	-2556.868426	0.995201	0.997601
11/08/2020	1095120	-5040.846473	-2520.423237	0.995397	0.997698
12/08/2020	1084698	-5060.159181	-2530.079591	0.995335	0.997667
13/08/2020	1217484	-4785.838579	-2392.91929	0.996069	0.998035
14/08/2020	1202389	-4764.983723	-2382.491862	0.996037	0.998019
15/08/2020	1131209	-4990.849478	-2495.424739	0.995588	0.997794
16/08/2020	1234411	-4779.749958	-2389.874979	0.996128	0.998064
17/08/2020	1173491	-4830.069426	-2415.034713	0.995884	0.997942