

METER ERROR REPORT**DRAFT / 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	Atherstone
LDZ	WM
START DATE (actual)	14 th March 2012
LAST GOOD DATE	13 th March 2012
END DATE	20 th February 2013
SIZE OF ERROR (No reconciliation required if under 0.1%)	12111267 scm over-registration (equivalent to 41%)
ESTIMATE – Y/N?	N
ROOT CAUSE	Mismatched firmware used.
ANALYSIS	HPMIS RBD data
METER TYPE	Turbine
AUTHOR	Piers Eldridge
CHECKED BY	Andrew Finch
ACCEPTED BY XXXXX NETWORK	

2. BACKGROUND

Gas is supplied to part of the NGGD Network via the East Midlands to West Midlands Inter-LDZ transfer. The Atherstone installation forms part of this transfer. The site meter system comprises a twin stream rotary turbine meter. The offtake feeds a medium pressure system via pressure controlled regulators. The relative density and calorific value is measured with a Tracker.

On the 19th February 2013 the Measurement and Process Group of Network Integrity was contacted because the technicians performing the detailed T/PR/ME/2 validation had some queries regarding the CP1 test.

Upon investigation, it was established that the flow computer was discovered to be calculating the density and compression factor Z incorrectly.

3. ERROR QUANTIFICATION AND IMPACT

Historic RBD data was reviewed. It was discovered that the flow computer commenced incorrect calculation of density and compression factor Z on 14th March 2012.

The density was therefore re-calculated for each of the 4 minute RBD and gas property data during the period of the error. In each instance, the density correction was applied to the gas flow during the 4 minute period.

From HPMIS, the reported flow through the site between 14th March 2012 and 20th February 2013 was 29.57 Mscm. The recalculated flow is 17.46Mscm. As a consequence, it was estimated that the metering system over-registered 12111267 scm of gas.

A spreadsheet detailing the calculations is available on request.

4. CAUSES

Following the swapping of an Omni flow computer CPU to deal with on board battery backup failure, a different version of EPROM firmware was inadvertently deployed. Whilst this was still applicable to a gas application, the version in question was not fully compatible with the OmniCom version that was resident on the supervisory system.

No obvious incompatibility was noted at the time, but from retrospective study, it is believed that at least one Modbus data location had changed between the respective firmware versions. Following a later attempted full T/PR/ME/2 validation, it was noted that the density calculation was not being undertaken appropriately. Further investigation revealed that the compression factor Z was being reported in excess of 1. The root cause was traced to an inappropriately set Base Pressure figure in the Fluid Product setup area in the firmware that was installed. Such a configuration option is not available in the present NGGD normally deployed versions of firmware.

OmniCom, installed on the supervisory system did not display this erroneous Base Pressure value in the Fluid Product setup area and all impressions given lead the operative to conclude that all was well with the resulting installation.

It is concluded that the firmware which was inadvertently installed was of a later build to that normally installed by NGGD and that the earlier version of OmniCom was not able to address the data point in question. In the absence of the capability of OmniCom to configure this parameter, it is concluded that the inappropriate default value (together with default engineering units) was auto-set by the firmware without the technician's knowledge.

As a result, the reference conditions for the AGA8 calculation were inappropriately set which resulted in incorrect density and compression factor Z derivation. This in turn impacted upon the reported flow rate.

Following extensive testing in a controlled environment, it was concluded that the unintended setup resulted in a calculation that was not always repeatable. For this reason, it was decided that density would be recalculated from first principles using CV, RD, CO₂, P and T and AGA8 Gross Characterisation before applying the flow calculation. This reconstituted flow was then compared with the reported flow to derive appropriate correction factors for the duration. The daily correction factors are shown in the appendix.

5. RECOMMENDATIONS AND LEARNING

As a general principle, and unless instructed otherwise by the Measurement and Process Group of Network Integrity, the same firmware version shall always remain resident pre/post works.

In the event that an exchange CPU is intended to be deployed to undertake this work, and it is not populated with the correct version of firmware, it is permissible to remove the EPROMs from the outgoing CPU and install them into the incoming CPU. This activity is however required to be undertaken with extreme caution since sub miniature decoupling capacitors are located immediately underneath the EPROMs and on top of the EPROM socket. These can be irreparably damaged by inappropriate extraction, rendering the CPU useless. For this reason, only a suitable EPROM IC extraction tool should ever be used to carry out the swap. In addition, suitable anti-static precautions should be taken at all times when undertaking this work. Any jumper settings should also be replicated.

In addition to applying standard pre and post checks, it is also recommended that additional attention is paid to the calculated compression factor Z and density. Any suspect values are required to be investigated before declaring the work complete.

REFERENCES

Network Technician
T/PR/ME/2
Measurement and Process Group of Network Integrity
HPMIS database

VERSION HISTORY

<i>Version</i>	<i>Changes</i>	<i>Author</i>	<i>Date</i>
<i>Rev 1</i>	<i>Final</i>	<i>Piers Eldridge</i>	<i>21/02/2013</i>

DISTRIBUTION

As appropriate

Appendix
Daily correction factors

Gas date	Volume scm	Volume error scm	Correction factor
14/03/2012	67963	23126.9	0.6597
15/03/2012	192522	78536.2	0.5921
16/03/2012	77352	31679.5	0.5905
17/03/2012	40303	15830.8	0.6072
18/03/2012	59420	23007.2	0.6128
19/03/2012	76762	31033.0	0.5957
20/03/2012	39359	14847.0	0.6228
21/03/2012	37333	14997.2	0.5983
22/03/2012	34139	13538.0	0.6034
23/03/2012	24218	10199.5	0.5788
24/03/2012	15457	6568.3	0.5751
25/03/2012	462	181.5	0.6071
26/03/2012	16920	6909.3	0.5916
27/03/2012	17420	7216.6	0.5857
28/03/2012	14029	5828.1	0.5846
29/03/2012	10195	4265.2	0.5816
30/03/2012	23919	9789.2	0.5907
31/03/2012	36379	15738.1	0.5674
01/04/2012	12222	4665.6	0.6183
02/04/2012	45422	19000.9	0.5817
03/04/2012	49390	19110.5	0.6131
04/04/2012	170527	72721.9	0.5735
05/04/2012	118718	44281.0	0.6270
06/04/2012	103615	42484.2	0.5900
07/04/2012	55196	21939.2	0.6025
08/04/2012	18107	7631.5	0.5785
09/04/2012	28864	12101.8	0.5807
10/04/2012	23215	9296.0	0.5996
11/04/2012	31036	13307.2	0.5712
12/04/2012	28754	11718.8	0.5924
13/04/2012	39631	16680.3	0.5791
14/04/2012	44234	18811.7	0.5747
15/04/2012	43149	17316.9	0.5987
16/04/2012	66521	27386.2	0.5883
17/04/2012	68824	28361.5	0.5879
18/04/2012	69847	30262.5	0.5667
19/04/2012	58796	24190.3	0.5886
20/04/2012	42922	17264.6	0.5978
21/04/2012	179606	75977.6	0.5770
22/04/2012	138409	55135.9	0.6016
24/04/2012	212657	82902.6	0.6102
25/04/2012	188312	81830.3	0.5655
26/04/2012	114390	45605.0	0.6013
27/04/2012	148763	62858.2	0.5775
28/04/2012	155273	66376.6	0.5725
29/04/2012	187521	81590.7	0.5649
30/04/2012	69183	26354.5	0.6191
01/05/2012	116973	50001.7	0.5725

02/05/2012	73388	28774.0	0.6079
03/05/2012	141659	59868.0	0.5774
04/05/2012	126772	49595.6	0.6088
05/05/2012	110143	43991.2	0.6006
06/05/2012	55376	21295.6	0.6154
07/05/2012	61581	25514.6	0.5857
08/05/2012	12317	4859.1	0.6055
09/05/2012	34975	14564.4	0.5836
11/05/2012	3439	1298.3	0.6225
12/05/2012	3228	1343.7	0.5837
14/05/2012	3945	1631.8	0.5864
15/05/2012	27386	11096.7	0.5948
16/05/2012	13603	5426.8	0.6011
17/05/2012	13264	5458.5	0.5885
18/05/2012	7011	2831.5	0.5961
19/05/2012	18678	8611.3	0.5390
20/05/2012	2634	1053.8	0.5999
21/05/2012	8410	3495.4	0.5844
22/05/2012	17101	7032.8	0.5888
08/06/2012	554	236.3	0.5736
23/09/2012	6562	3000.2	0.5428
24/09/2012	79823	35934.1	0.5498
25/09/2012	99066	42985.5	0.5661
26/09/2012	73625	28809.0	0.6087
27/09/2012	49551	17314.4	0.6506
28/09/2012	78939	30770.1	0.6102
29/09/2012	66445	27296.0	0.5892
30/09/2012	80678	33996.7	0.5786
01/10/2012	53290	20702.4	0.6115
02/10/2012	72225	30213.0	0.5817
03/10/2012	77487	30820.1	0.6023
04/10/2012	72066	28758.4	0.6009
05/10/2012	91254	37667.2	0.5872
06/10/2012	57098	23295.0	0.5920
07/10/2012	48596	19754.8	0.5935
08/10/2012	54797	22906.7	0.5820
09/10/2012	58517	23781.2	0.5936
10/10/2012	56988	23202.4	0.5929
11/10/2012	61559	25157.9	0.5913
12/10/2012	49972	19857.8	0.6026
13/10/2012	67292	28858.4	0.5711
14/10/2012	81970	32355.2	0.6053
15/10/2012	102309	41621.7	0.5932
16/10/2012	98220	39381.6	0.5990
17/10/2012	73081	29484.4	0.5966
18/10/2012	114237	45832.6	0.5988
19/10/2012	125751	52296.2	0.5841
20/10/2012	103393	42940.4	0.5847
21/10/2012	85675	35051.1	0.5909
22/10/2012	79897	33452.1	0.5813
23/10/2012	93834	38075.6	0.5942
24/10/2012	67441	27457.9	0.5929

25/10/2012	93813	37384.6	0.6015
26/10/2012	130280	52638.4	0.5960
27/10/2012	156468	64528.4	0.5876
28/10/2012	124527	48088.2	0.6138
29/10/2012	113154	43165.0	0.6185
30/10/2012	129426	52287.2	0.5960
31/10/2012	134545	55412.7	0.5881
01/11/2012	146210	57757.6	0.6050
02/11/2012	155810	62004.0	0.6021
03/11/2012	155357	63388.5	0.5920
04/11/2012	169520	70982.7	0.5813
05/11/2012	177210	71389.4	0.5971
06/11/2012	186478	79436.2	0.5740
07/11/2012	146598	56354.3	0.6156
08/11/2012	136482	54118.7	0.6035
09/11/2012	125258	51336.5	0.5902
10/11/2012	115773	47152.3	0.5927
11/11/2012	126139	51509.0	0.5916
12/11/2012	138436	56791.2	0.5898
13/11/2012	101947	39410.9	0.6134
14/11/2012	110586	43449.1	0.6071
15/11/2012	162641	64660.5	0.6024
16/11/2012	155412	62614.1	0.5971
17/11/2012	125891	49420.3	0.6074
18/11/2012	152092	61500.6	0.5956
19/11/2012	179349	73956.5	0.5876
20/11/2012	142345	56485.3	0.6032
21/11/2012	70106	30619.2	0.5632
22/11/2012	66011	27656.9	0.5810
23/11/2012	72592	29425.6	0.5946
24/11/2012	109509	47988.2	0.5618
25/11/2012	35310	13941.1	0.6052
26/11/2012	66367	27301.7	0.5886
27/11/2012	95923	38584.0	0.5978
28/11/2012	143081	56938.5	0.6021
29/11/2012	193432	75820.8	0.6080
30/11/2012	228546	94098.9	0.5883
01/12/2012	196512	79296.2	0.5965
02/12/2012	179394	71061.7	0.6039
03/12/2012	180173	72933.8	0.5952
04/12/2012	216143	89639.8	0.5853
05/12/2012	245203	98577.2	0.5980
06/12/2012	287233	121669.0	0.5764
07/12/2012	214259	87136.6	0.5933
08/12/2012	150540	60170.6	0.6003
09/12/2012	153052	61132.5	0.6006
10/12/2012	241980	100147.4	0.5861
11/12/2012	303912	124619.2	0.5899
12/12/2012	288313	112562.7	0.6096
13/12/2012	303621	124408.5	0.5903
14/12/2012	228213	95452.3	0.5817
15/12/2012	157650	63829.7	0.5951

16/12/2012	124872	50798.7	0.5932
17/12/2012	165658	66857.8	0.5964
18/12/2012	182637	72742.2	0.6017
19/12/2012	195656	77263.5	0.6051
20/12/2012	188324	77817.6	0.5868
21/12/2012	163720	69730.8	0.5741
22/12/2012	150505	65974.0	0.5616
23/12/2012	146725	58027.2	0.6045
24/12/2012	190705	81265.6	0.5739
25/12/2012	169249	72637.9	0.5708
26/12/2012	163135	68234.0	0.5817
27/12/2012	192413	80312.1	0.5826
28/12/2012	193096	84925.2	0.5602
29/12/2012	156594	64182.7	0.5901
30/12/2012	170149	72084.3	0.5763
31/12/2012	145557	56547.8	0.6115
01/01/2013	149841	57043.6	0.6193
02/01/2013	181134	76176.9	0.5794
03/01/2013	152254	60459.1	0.6029
04/01/2013	143128	58837.8	0.5889
05/01/2013	121774	50590.6	0.5846
06/01/2013	124487	52083.7	0.5816
07/01/2013	166224	69016.0	0.5848
08/01/2013	163314	64293.8	0.6063
09/01/2013	152278	58434.4	0.6163
10/01/2013	188202	78190.2	0.5845
11/01/2013	195634	81894.2	0.5814
12/01/2013	185397	75915.4	0.5905
13/01/2013	184738	74701.9	0.5956
14/01/2013	284696	123218.3	0.5672
15/01/2013	298586	124962.7	0.5815
16/01/2013	376961	163476.2	0.5663
17/01/2013	364178	152036.2	0.5825
18/01/2013	380978	161265.3	0.5767
19/01/2013	312248	130533.6	0.5820
20/01/2013	293199	118509.6	0.5958
21/01/2013	343813	142559.8	0.5854
22/01/2013	342308	137611.4	0.5980
23/01/2013	353254	145998.1	0.5867
24/01/2013	345319	139762.8	0.5953
25/01/2013	358598	148250.6	0.5866
26/01/2013	265628	106915.8	0.5975
27/01/2013	205094	79136.9	0.6141
28/01/2013	309741	139502.8	0.5496
29/01/2013	183830	76364.6	0.5846
30/01/2013	175744	69285.6	0.6058
31/01/2013	209357	86286.3	0.5879
01/02/2013	184639	71683.2	0.6118
02/02/2013	215941	87964.2	0.5926
03/02/2013	195029	83456.6	0.5721
04/02/2013	200716	76995.6	0.6164
05/02/2013	267583	110390.5	0.5875

06/02/2013	286979	115878.2	0.5962
07/02/2013	273903	111331.8	0.5935
08/02/2013	269470	109737.3	0.5928
09/02/2013	227562	91750.2	0.5968
10/02/2013	227621	92021.5	0.5957
11/02/2013	289000	114469.8	0.6039
12/02/2013	315162	127886.5	0.5942
13/02/2013	358355	153550.3	0.5715
14/02/2013	221204	87954.2	0.6024
15/02/2013	213197	88888.2	0.5831
16/02/2013	198329	83055.9	0.5812
17/02/2013	154819	60989.2	0.6061
18/02/2013	220616	89156.7	0.5959
19/02/2013	254366	107261.3	0.5783
20/02/2013	167844	20429.6	0.8783