



Measurement Error Report

Air Liquide UK Ltd

MER_CAD_212_21 Barnes Farm BNEF

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1 Revision Control

Rev	Issue date	Description	Prep.	App.
1	10/08/2021	Issued for comment	BK	DS
2	22/09/2021	Final	BK	DS
2.1	28/09/2021	Revised Final (Energy reconciliation)	BK	DS

2 Executive Summary

Site Name	Barnes Farm BNEF
DNO	Cadent Gas Limited
LDZ	West Midlands
Error Start Date	16 th August 2020
(Or) Last Good Date	
Error Corrected Date	14 th April 2021
Size of Error (over or under read)	1,510.42 Sm ³ under-registration (approximately 0.016 GWh)
Error Description	Intermittent erroneous USM flow readings
Methodology	Comparison of inlet meter and fiscal meter flow readings
Meter Type	Ultrasonic meter
MER Unique Reference Number	-
Cadent Internal Reference	MER/CAD/212/21

3 Error Description

Barnes Farm BNEF has a single 2" Sick Flowsic500 ultrasonic meter stream for measurement of gas exiting the grid entry unit (GEU) and entering the distribution network (referred to in this report as 'Fiscal USM'). A 2" GE turbine meter is located on the inlet to the GEU for process control (referred to in this report as 'Inlet Meter'). Propane injection is used to control the gas properties (e.g. calorific value, Wobbe number, etc.) to meet the requirements of the Gas Safety (Management) Regulations (GS(M)R). Gas that is not within specification is rejected by a diverter valve.

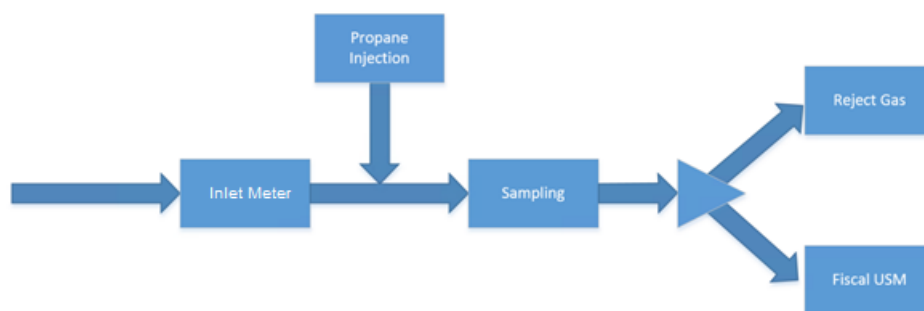


Figure 1 - Grid Entry Unit Flow Diagram

During normal operation the Fiscal USM will read slightly higher (~12.5 Sm³/h) than the Inlet Meter due to the addition of propane. On a number of occasions between 16th August 2020 and 15th January 2021 the Fiscal USM intermittently read much higher or lower than the Inlet Meter for prolonged periods of time. The error was first detected on 16th August 2020 when the Fiscal USM read an uncorrelated spike in flow rate followed by a constant reading considerably lower than the Inlet Meter for a prolonged period.

3.1 Error Period 1 – 16th to 17th August 2020

At 22:45 on 16th August 2020, the Fiscal USM read ~172 Sm³/h higher than the Inlet Meter for one minute before dropping to a flow of ~160 Sm³/h. Records show the ROV position changed from open to closed at 22:48, therefore the Fiscal USM flow rate should have been zero. The over-reading continued until 02:18 on 17th August 2020. The process was restarted at 09:59 and the correct flow rates were registered. This error period has already been corrected in the Gemini billed daily volumes and therefore no further reconciliation is required.

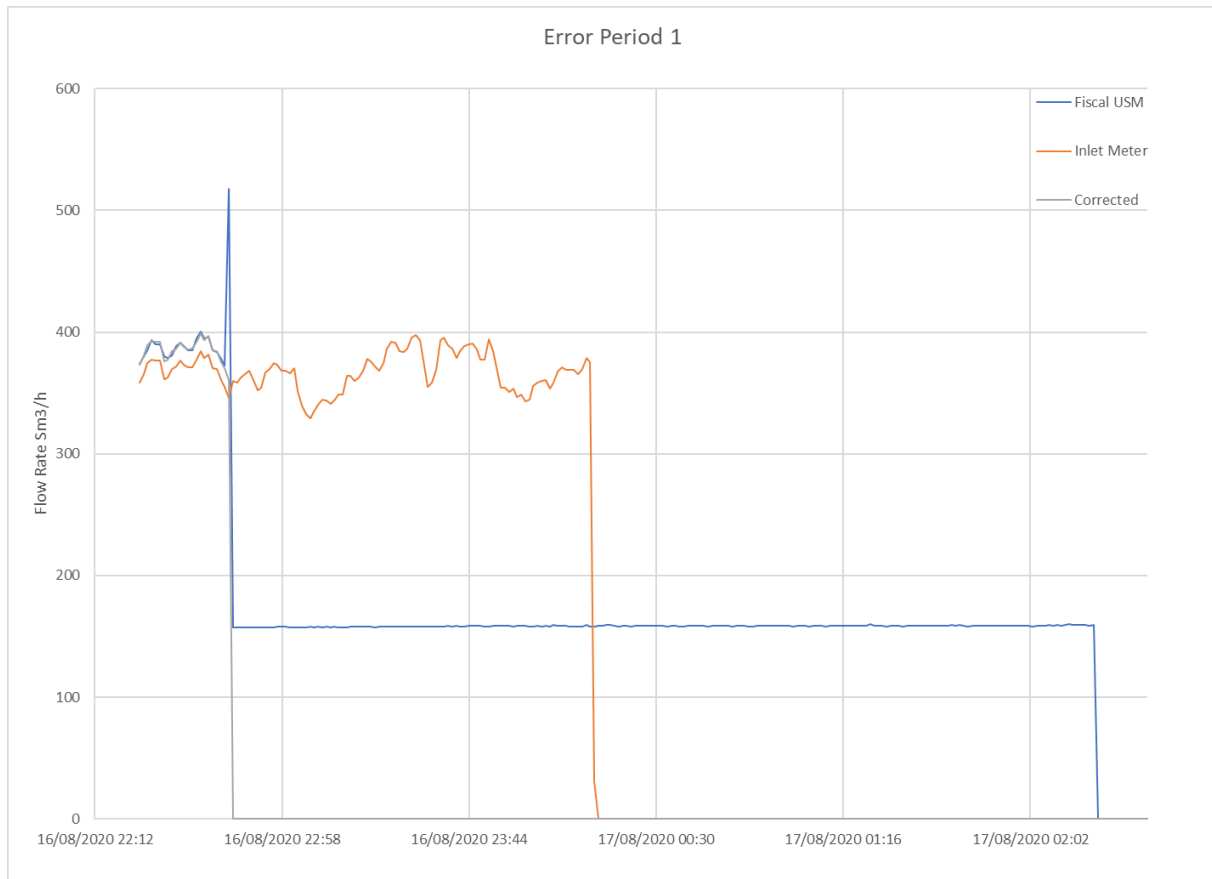


Figure 2. Error Period 1 – 16th to 17th August 2020

3.2 Error Period 2 – 3rd September 2020

At 04:52 on 3rd September 2020, the Fiscal USM dropped to a flow rate of ~160 Sm³/h. Records show the ROV position changed from open to closed at 04:55, therefore the Fiscal USM flow rate should have been zero. The over-reading continued until 11:31 on 3rd September 2020. The process was restarted at 12:38 and the correct flow rates were registered.

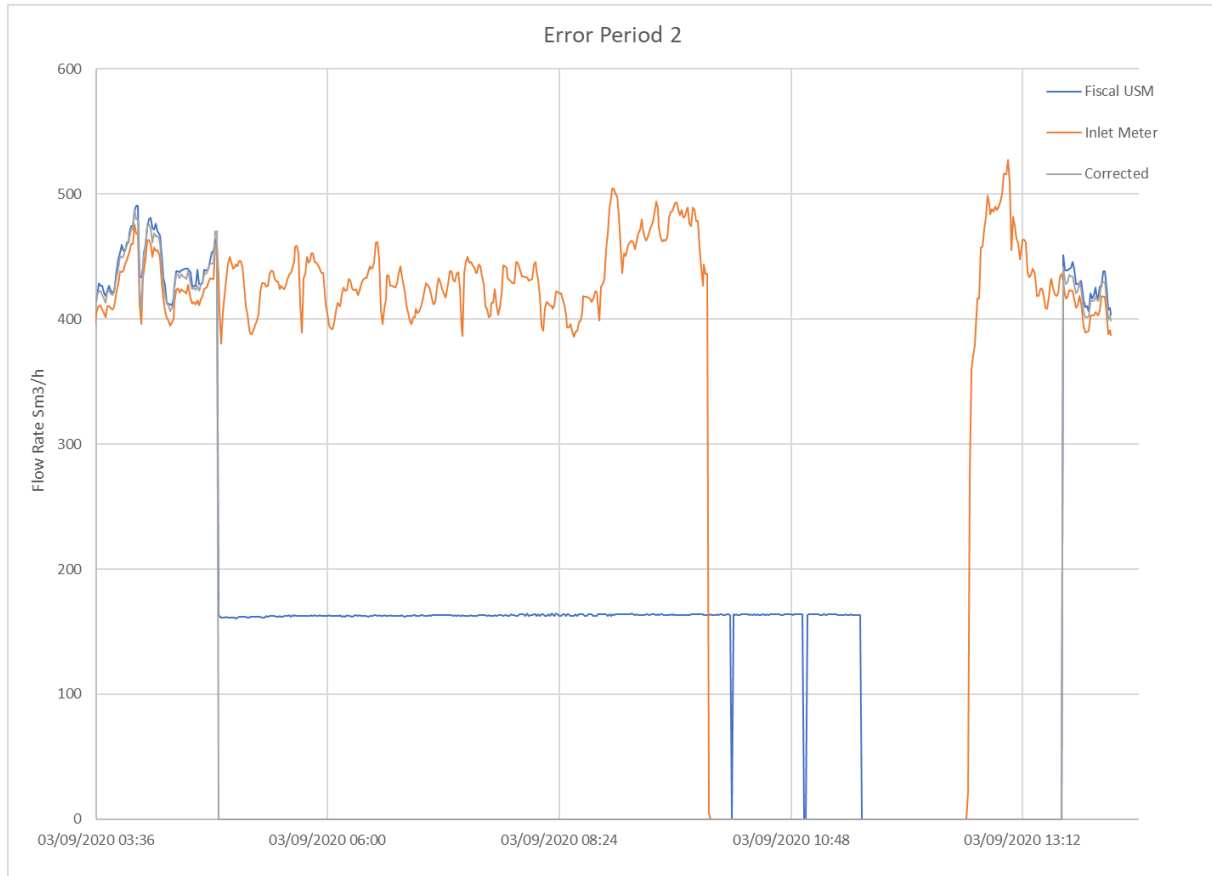


Figure 3. Error Period 2 -3rd September 2020

3.3 Error Period 3 – 3rd October 2020

At 05:00 on 3rd October 2020, the Fiscal USM started to read ~146 Sm³/h lower than the Inlet Meter. The process was halted at 14:53 with no flow through both the Inlet and Fiscal USM. At 18:53 the Inlet Meter began reading a flow and the diverter valve set to reject. The gas-to-grid valve was opened at 20:38 with the Fiscal USM reading correctly (~12 Sm³/h higher than the Inlet Meter).

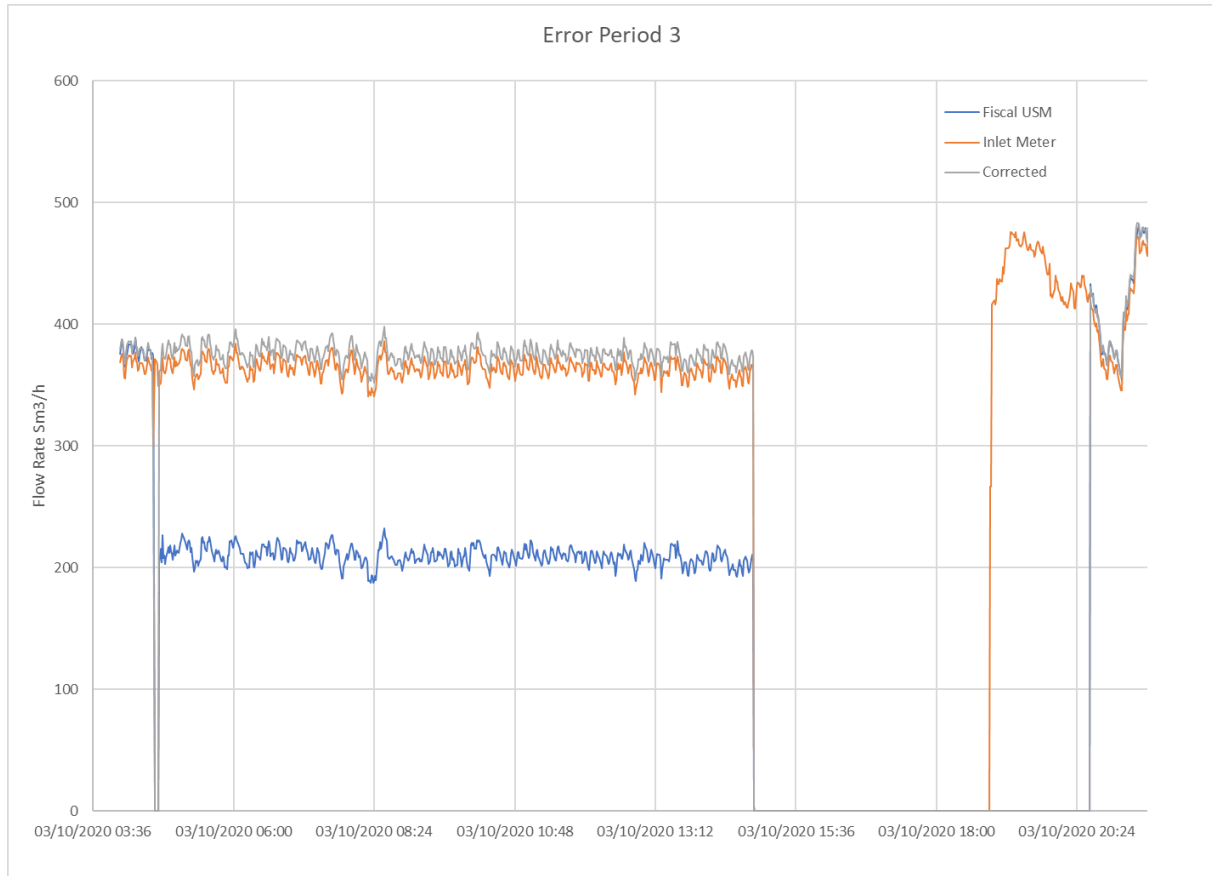


Figure 4. Error Period 3 – 3rd October 2020

3.4 Error Period 4 – 4th October 2020

At 20:16 on 4th October 2020 the diverter valve was set to reject for three minutes. Once the flow to the grid was resumed the Fiscal USM began under reading (~184 Sm³/h under Inlet Meter), until 21:39, at which point the Fiscal USM resumed its correct reading of ~10 Sm³/h higher than the Inlet Meter.

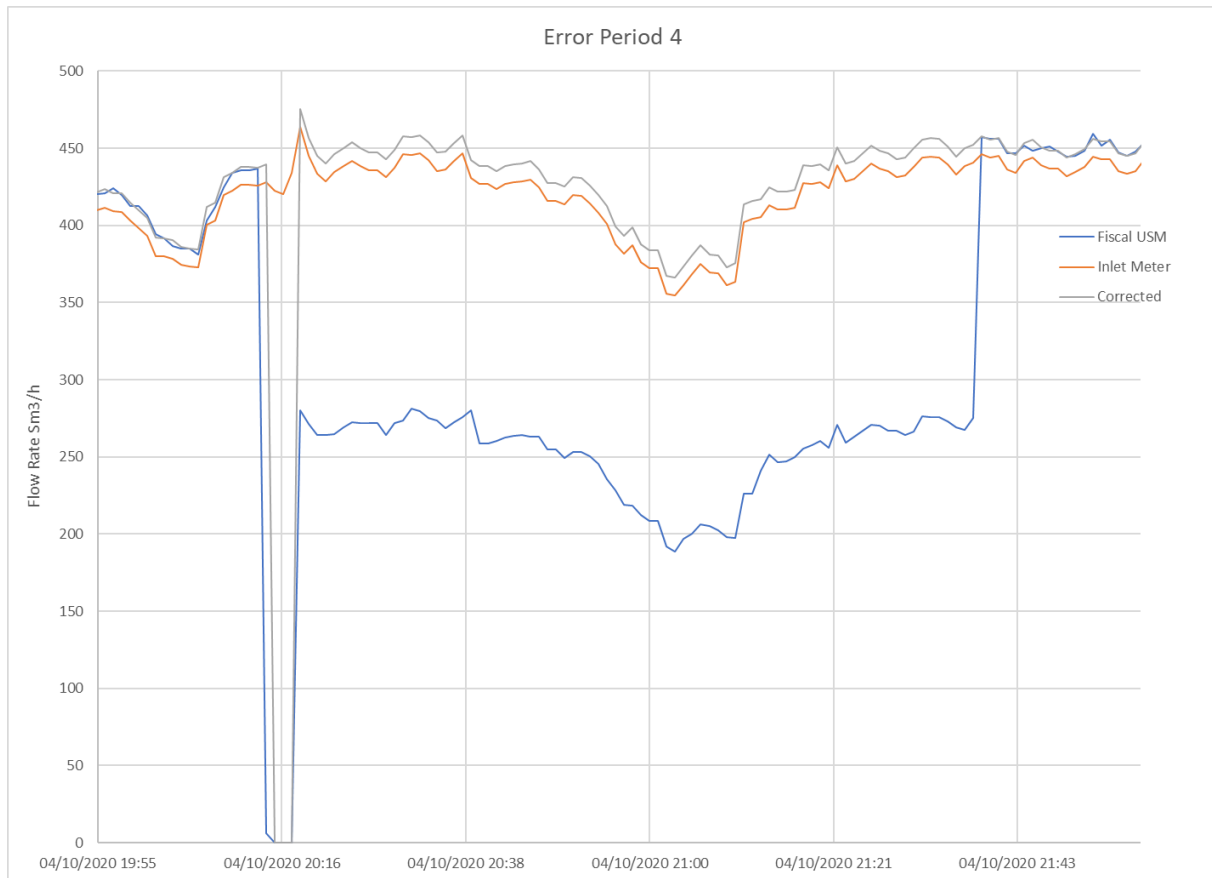


Figure 5. Error Period 4 – 4th October 2020

3.5 Error Period 5 – 5th October 2020

At 09:39 on 5th October 2020 the diverter valve was set to reject for three minutes. Once the flow to the grid was resumed the Fiscal USM began under reading, measuring only ~1.77 Sm³/h higher than the Inlet Meter (Average offset during this period, 11.71 Sm³/h). The under reading continued until 12:06 on the 5th October 2020, when the process was halted. When the gas began to flow again at 12:51, it was rejected until the gas-to-grid valve was opened at 13:33, when the gas began flowing to the grid. However, the Fiscal USM measured ~174 Sm³/h below the Inlet Meter reading for 6 minutes, before correctly reading the flow again.

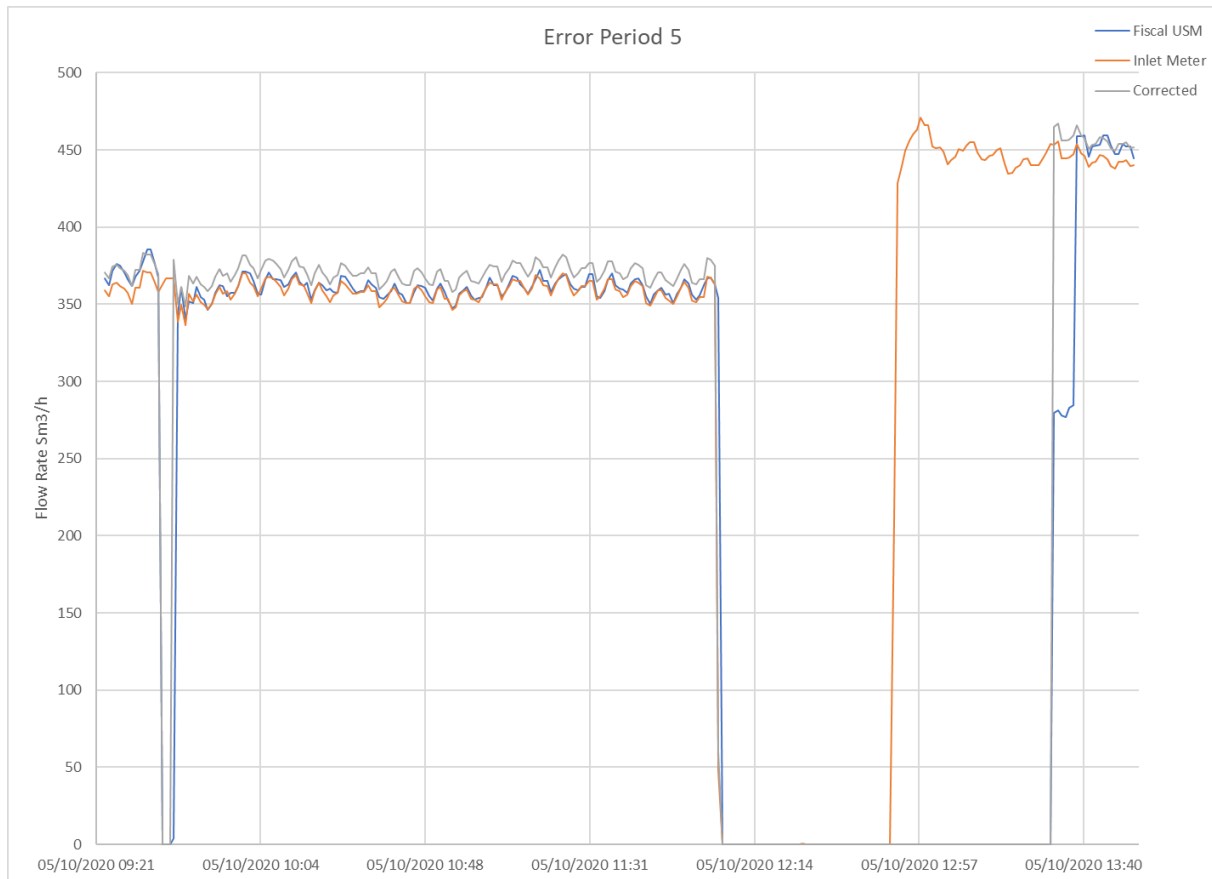


Figure 6. Error Period 5 – 5th October 2020

3.6 Error Period 6 – 5th to 6th October 2020

At 18:51 on 5th October 2020 communication with the Inlet Meter was lost until 21:43. At which point the gas was diverted to reject for three minutes. Once the gas-to-grid valve was opened, the Fiscal USM began under reading by ~157 Sm³/h. The Fiscal USM continued under reading until 08:03 on 6th October 2020, when the process was stopped.

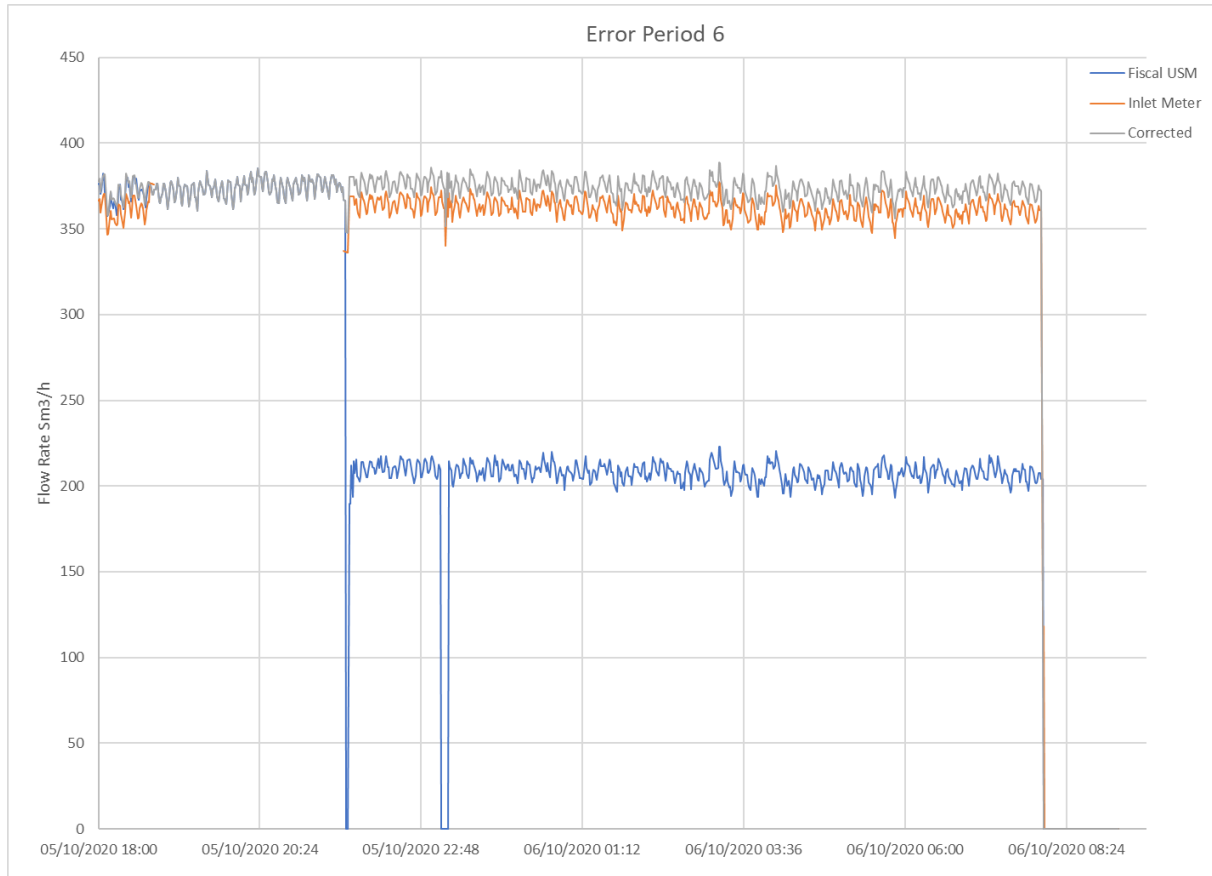


Figure 7. Error Period 6 – 5th to 6th October 2020

3.7 Error Period 7 – 6th October 2020

At 17:15 on 6th October 2020 the Fiscal USM began reading a flow of ~160 Sm³/h while the ROV was closed. The reject process began at 19:56 with the Inlet Meter measuring ~450 Sm³/h, however the ROV remained closed until 22:25. Therefore the Fiscal USM should have recorded a flow rate of zero. The gas-to-grid valve was opened at 00:14 with the Fiscal USM reading correctly (~12 Sm³/h higher than the Inlet Meter). This error period has already been corrected in the Gemini billed daily volumes and therefore no further reconciliation is required.

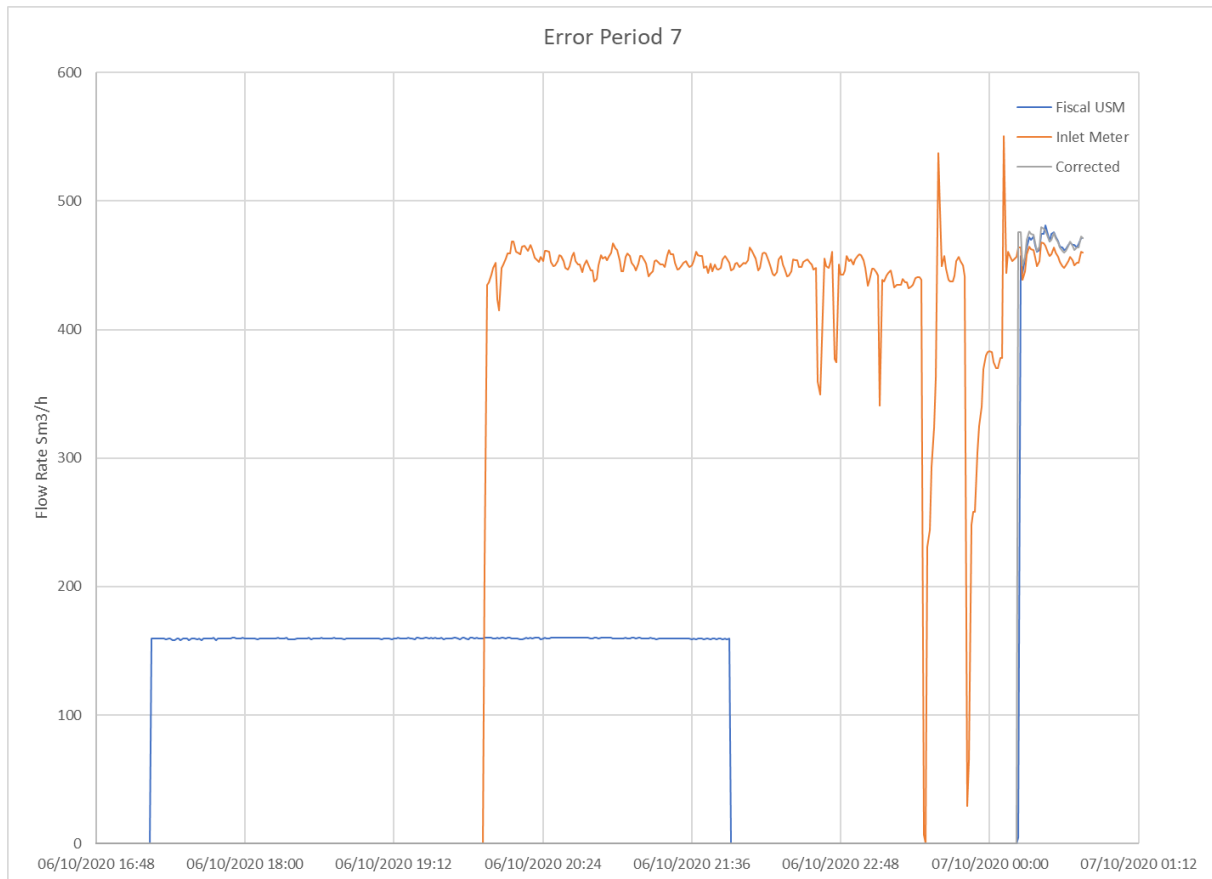


Figure 8. Error Period 7 - 6th October 2020

3.8 Error Period 8 – 9th December 2020

At 20:30 on 9th December 2020, the Fiscal USM dropped to a flow of ~160 Sm³/h. Records show the ROV position changed from open to closed at 20:32, therefore the Fiscal USM flow rate should have been zero. The over-reading continued until 02:05 on 10th December 2020. The reject process was restarted at 09:57 and the correct flow rates were registered.

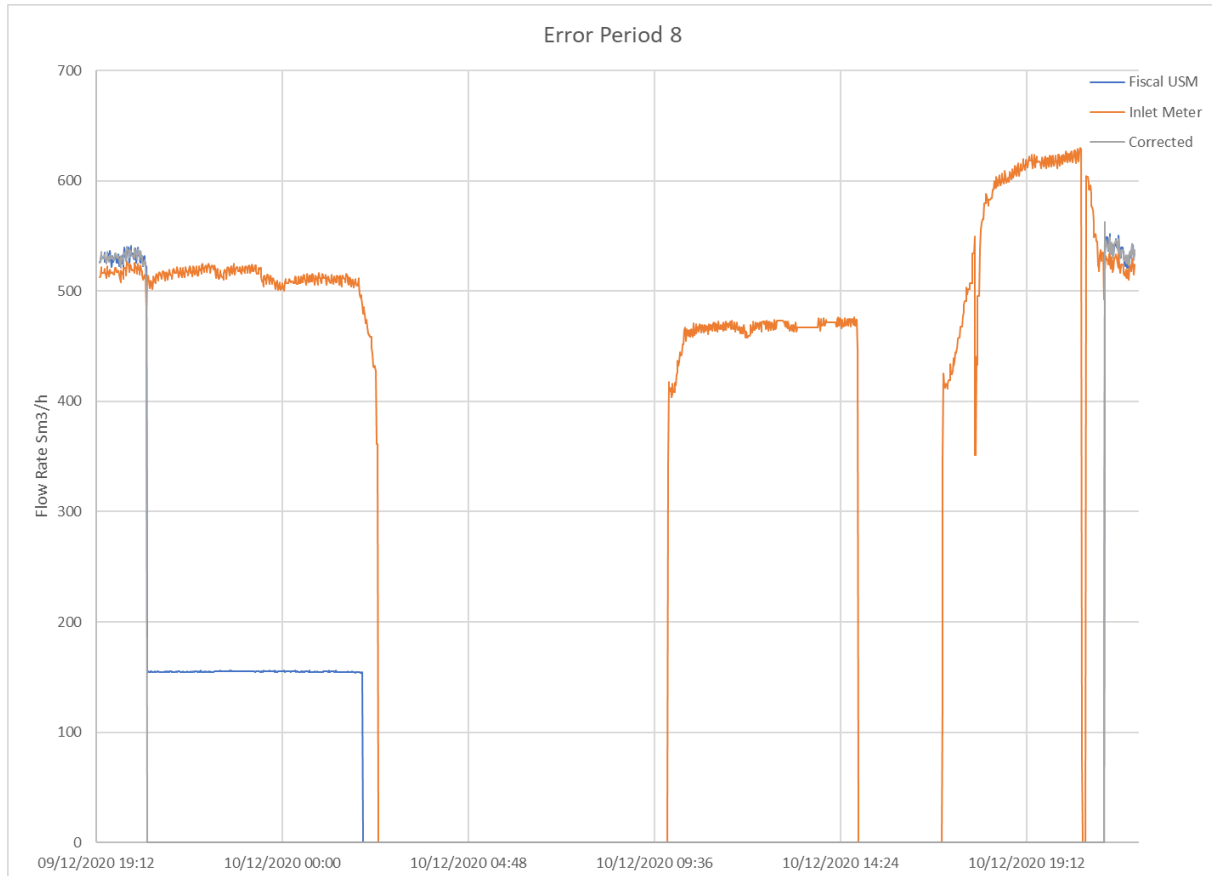


Figure 9. Error Period 8 – 9th December 2020

3.9 Error Period 9 – 27th December 2020

At 18:57 on 27th December 2020, the Fiscal USM dropped to a flow of ~160 Sm³/h. Records show the ROV position changed from open to closed at 18:59, therefore the Fiscal USM flow rate should have been zero. The over-reading continued until 20:07.

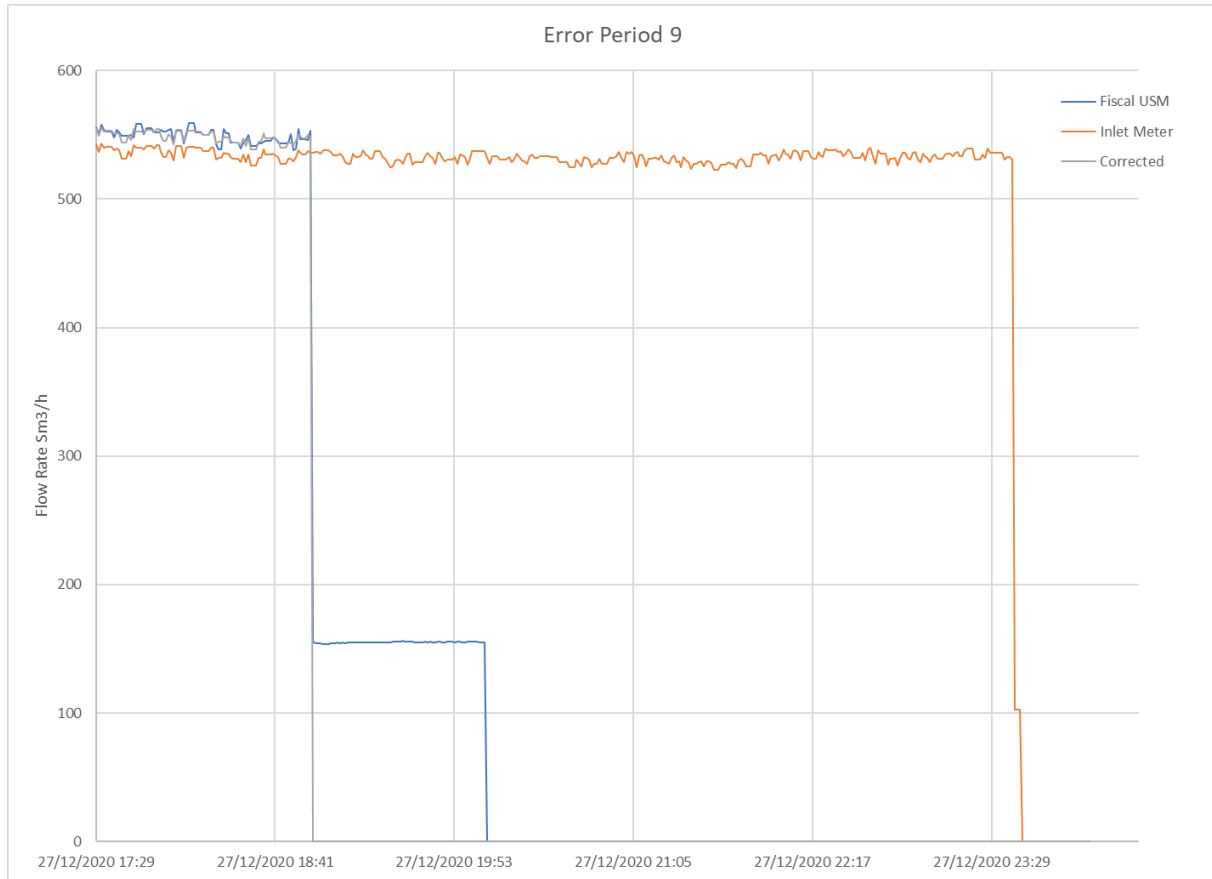


Figure 10. Error Period 9 – 27th December 2020

3.10 Error Period 10 – 15th January 2021

At 05:59 on 15th January 2021, the Fiscal USM dropped to a flow rate of ~160 Sm³/h. Records show the ROV position changed from open to closed at 06:00, therefore the Fiscal USM flow rate should have been zero. The over-reading continued until 06:08. The ROV was opened at 06:53, the gas-to-grid valve opened at 07:07 and the correct flow rates were registered.

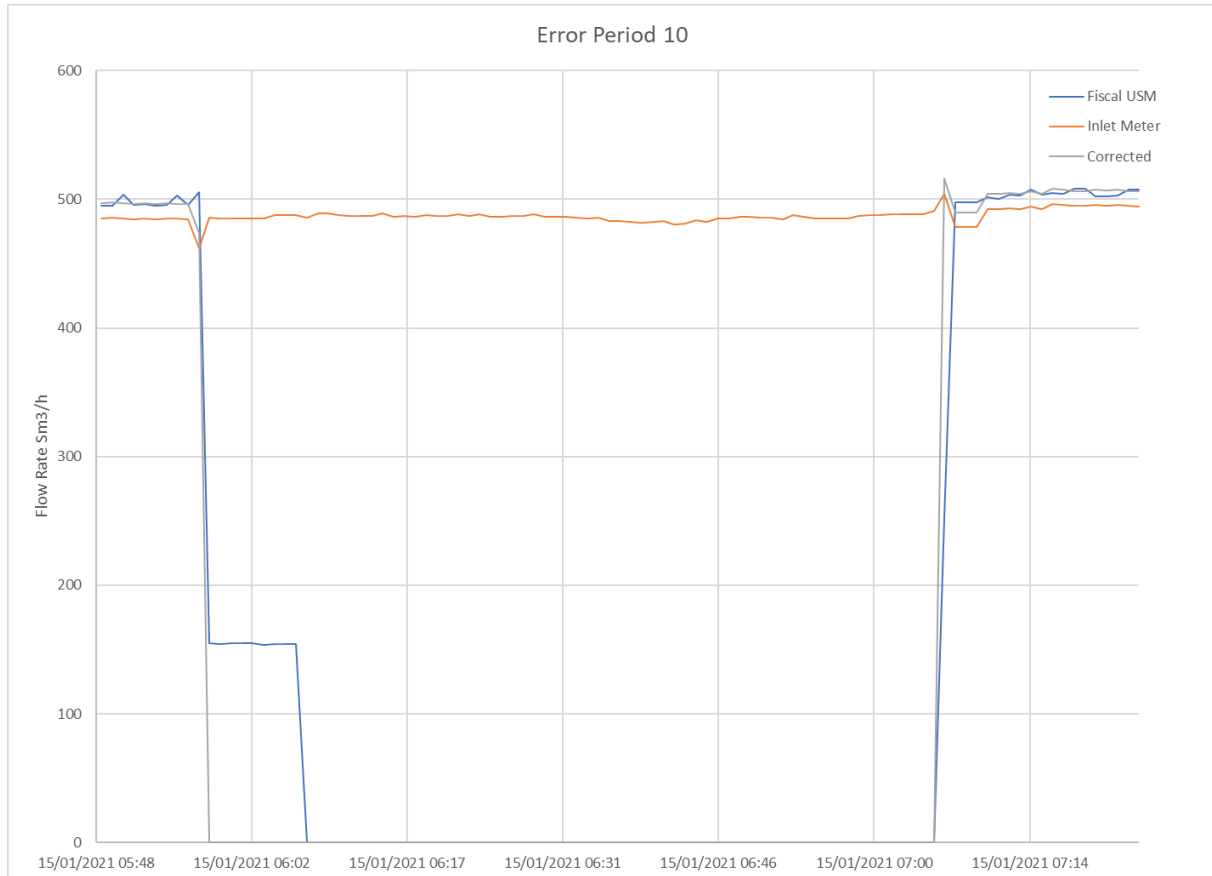


Figure 11. Error Period 10 – 15th January 2021

4 Methodology

The offset between the Inlet Meter and Fiscal USM during normal operation was calculated from the days of normal operation surrounding each error period (refer to Table 1). The Fiscal USM volume flow was then corrected (on a 1-minutely basis) using the Inlet Meter volume flow plus the offset for that period. Two sets of volume totals were calculated: one using the measured Fiscal USM flow and another using the corrected Fiscal USM flow, the error being the difference between the two.

Error Period	Date	Average Offset Sm ³
1	16 th to 17 th August 2020	+14.86
2	2 nd to 3 rd September 2020	+16.29
3	3 rd October 2020	+11.84
4	4 th October 2020	+10.10
5	5 th October 2020	+11.71
6	5 th to 6 th October 2020	+10.83
7	6 th October 2020	+10.83
8	9 th to 10 th December 2020	+13.19
9	27 th December 2020	+12.58
10	15 th January 2021	+11.82

Table 1 - Fiscal USM Average Offset from Inlet Meter

5 Error Quantification

Error periods 1 and 7 have already been corrected in the Gemini billed data and therefore no further reconciliation is required.

Error Period	Date	Total Error Sm ³
1	16 th August 2020	+565.39
7	6 th October 2020	+744.74

Table 2 – Error Periods Previously Corrected

The total reconcilable error is estimated to be an under-registration of 1,510.42 Sm³. The error for each period is detailed in Table 3. The error should be corrected using the daily correction factors in Appendix A.

Error Period	Date	Total Error Sm ³
2	2 nd to 3 rd September 2020	+1,078.93
3	2 nd to 3 rd October 2020	-1,683.81
4	4 th October 2020	-237.53
5	5 th October 2020	-41.24
6	5 th to 6 th October 2020	-1,689.54
8	9 th December 2020	+863.16
9	27 th December 2020	+180.71
10	15 th January 2021	+18.90
Total		-1510.42

Table 3 – Reconcilable Error Periods

6 Learning

The exact cause of the intermittent erroneous readings is not known although contamination of the transducers is one potential source. Further investigation into the root causes of the equipment error is recommended, including through the equipment manufacturer.

7 References

Barnes Farm GEU Data Files

Gemini Daily Data

MER_CAD_212_21_Barnes_Farm_Data.xlsx - Calculation Data spreadsheet

8 Appendix A – Daily Correction Factors

The error should be corrected using the Daily Correction Factors applied to the Gemini Daily Energy as detailed below.

	Gemini Energy (kWh)	Daily Correction Factor
<i>16-Aug-20</i>	37,518	<i>1</i>
02-Sep-20	87,778	0.997299
03-Sep-20	82,501	0.860989
02-Oct-20	111,945	1.004290
03-Oct-20	61,112	1.292260
04-Oct-20	85,556	1.030228
05-Oct-20	80,001	1.166897
06-Oct-20	30,586	1.176905
09-Dec-20	98,890	0.905432
27-Dec-20	50,278	0.960722
15-Jan-21	128,890	0.998399