



Measurement Error Report

IH E&I Services Ltd

MER NO016 Howdon BNEF

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Document Author: Ben Kirkman

Contact: ben.kirkman@kelton.co.uk

Kelton Engineering Ltd

The Mackenzie Building, 168 Skene Street
Aberdeen, AB10 1PE, Scotland, UK

t: +44 (0) 1224 630000 | f: +44 (0) 1224 630004
e: info@kelton.co.uk | w: www.kelton.co.uk

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1 Revision Control

Rev	Issue date	Description	Prep.	App.
1	31/01/2020	Issued for comment	BK	KV
2	23/03/2021	Renumbered	BK	KV

2 Executive Summary

Site Name	Howdon BNEF
DNO	Northern Gas Networks
LDZ	North
Error Start Date	27 th March 2019
(Or) Last Good Date	
Error Corrected Date	21 st January 2020
Size of Error (over or under read)	317,409 Sm ³ under-registration (approximately 3.5 GWh)
Error Description	Intermittent missed pulses from rotary meter & Errors in Gemini billed data
Methodology	Comparison of inlet meter and fiscal meter flow readings
Meter Type	Rotary meter
MER Unique Reference Number	NO016
NGN Internal Reference	MERNO016

3 Error Description

Howdon BNEF has a single 3" GE RootsMeter rotary positive displacement meter stream for measurement of gas exiting the grid entry unit (GEU) and entering the distribution network (referred to in this report as 'Fiscal Meter'). A second 3" Itron Fluxi 2000 turbine meter is located at the outlet of the clean-up plant 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). The propane injection is metered using a 1/8" Endress+Hauser Promass A Coriolis meter. Gas that is not within specification is rejected by a diverter valve. During normal operation the total of the Inlet Meter and Propane Meter flows is the same as the Fiscal Meter flow (refer to Figure 2).

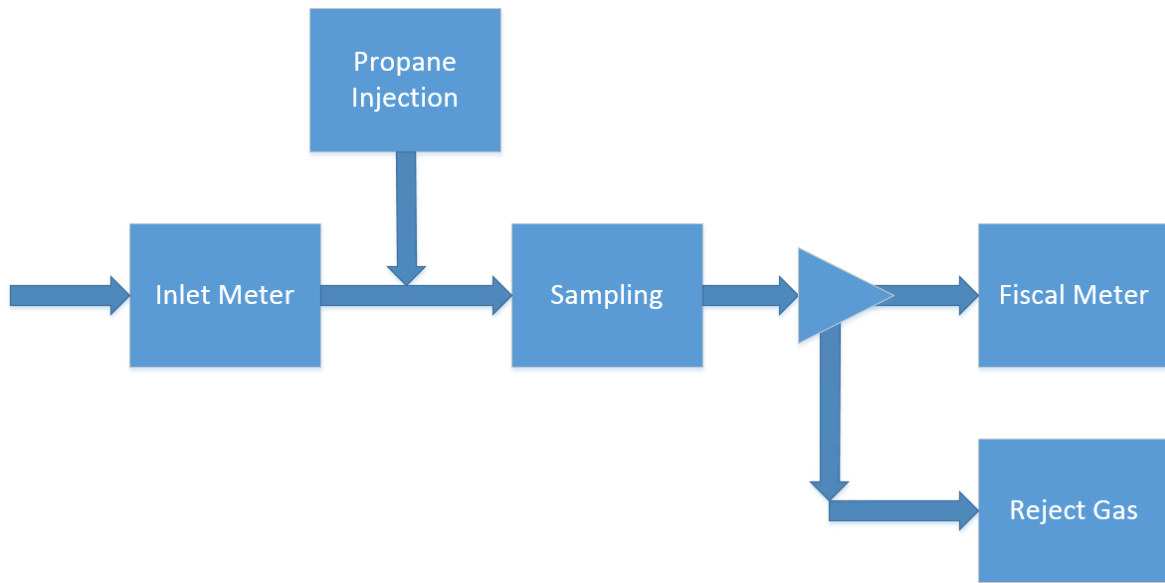


Figure 1 - Grid Entry Unit Flow Diagram

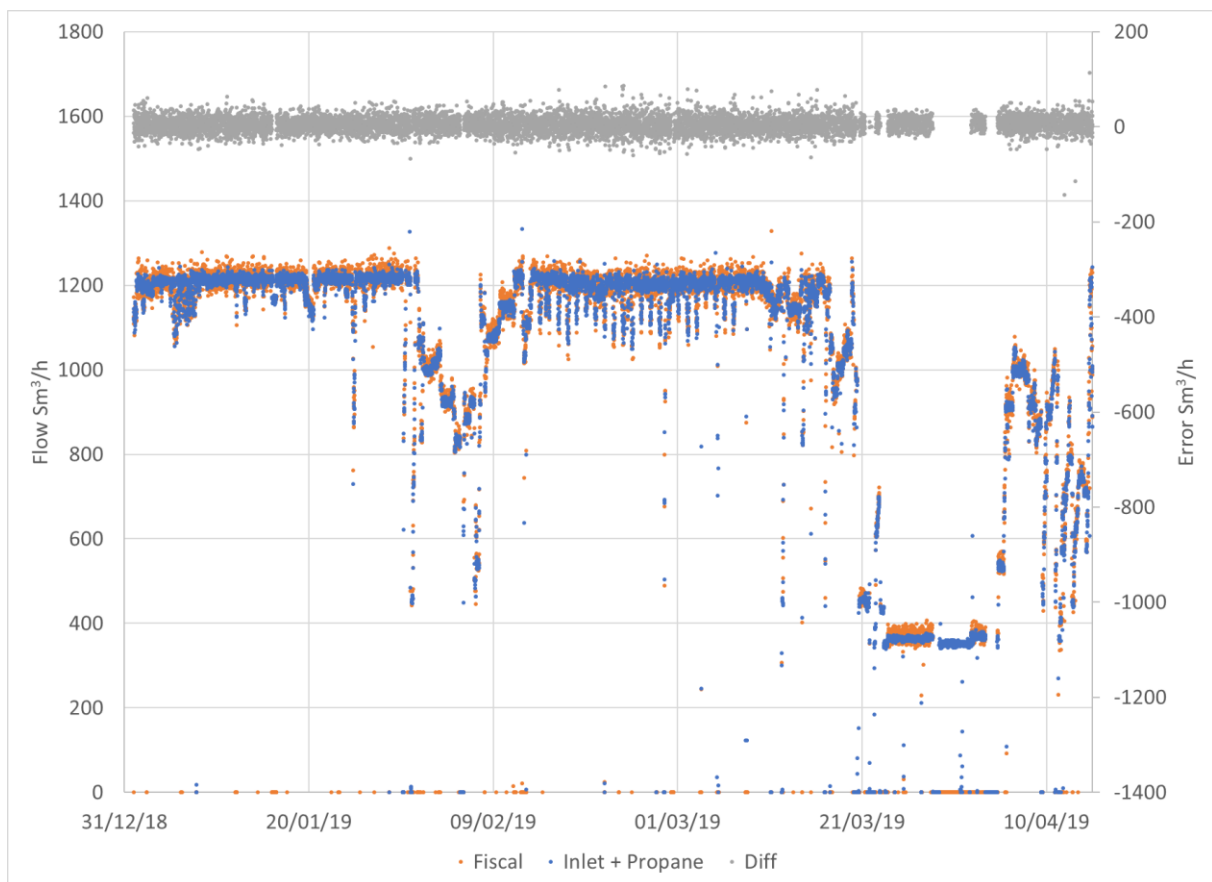


Figure 2 - Normal Healthy Operation

3.1 Measurement Error

On a number of occasions in May 2019 it was noted that the Fiscal Meter was reading lower than the total of the Inlet Meter and Propane Meter. The problem was intermittent but became more frequent in December 2019. When the archived data was reviewed it was apparent that the problem had first occurred on 16th April 2019 and was present intermittently until the meter was changed on 21st January 2020.

Refer to Figures 3 and 4 which highlight the significant error periods and the point at which the meter was replaced.

The under-reading is thought to be due to the bearings on the internal mechanism going out of alignment causing pulses to be missed.

3.2 Gemini Data Flow Error

When the archived Gemini data was reviewed a number of erroneous entries were detected, where the previous entry was duplicated.

4 Methodology

4.1 Measurement Error

The archived Inlet Meter data, presented in Nm³/h, was converted to Sm³/h using a conversion factor of 1.0553 (approximation for pure methane). The archived propane injection data, presented in kg/h, was converted to Sm³/h using a Standard density (for pure propane) of 1.89896 kg/Sm³.

The total inlet flow (Inlet Meter + Propane Meter) was compared to the Fiscal Meter and showed good agreement. The data was compared for a known healthy period 1st January 2019 to 10th April 2019 (refer to Figure 2) and a correlation function was derived to remove any offset. The 'corrected Fiscal flow' was calculated using the total inlet flow corrected for the offset (using the correlation function).

Two sets of daily volume totals were calculated, one using the measured Fiscal Meter flow and another using the 'corrected Fiscal flow', the error being the difference between the two.

The Inlet Meter and propane injection data was only available on a 15-minute basis which resulted in deviations in the calculated errors. Due to the shortcomings in the method, days with errors below $\pm 2\%$ were excluded from the reconciliation.

4.2 Gemini Data Flow Error

Gemini Data was compared to the flow computer integrator readings for each gas day and was in good agreement apart from a few days. It was noted that on these days the Gemini reading was identical to the previous day, which is highly unlikely. The daily totals for these days were corrected using the flow computer integrator readings.

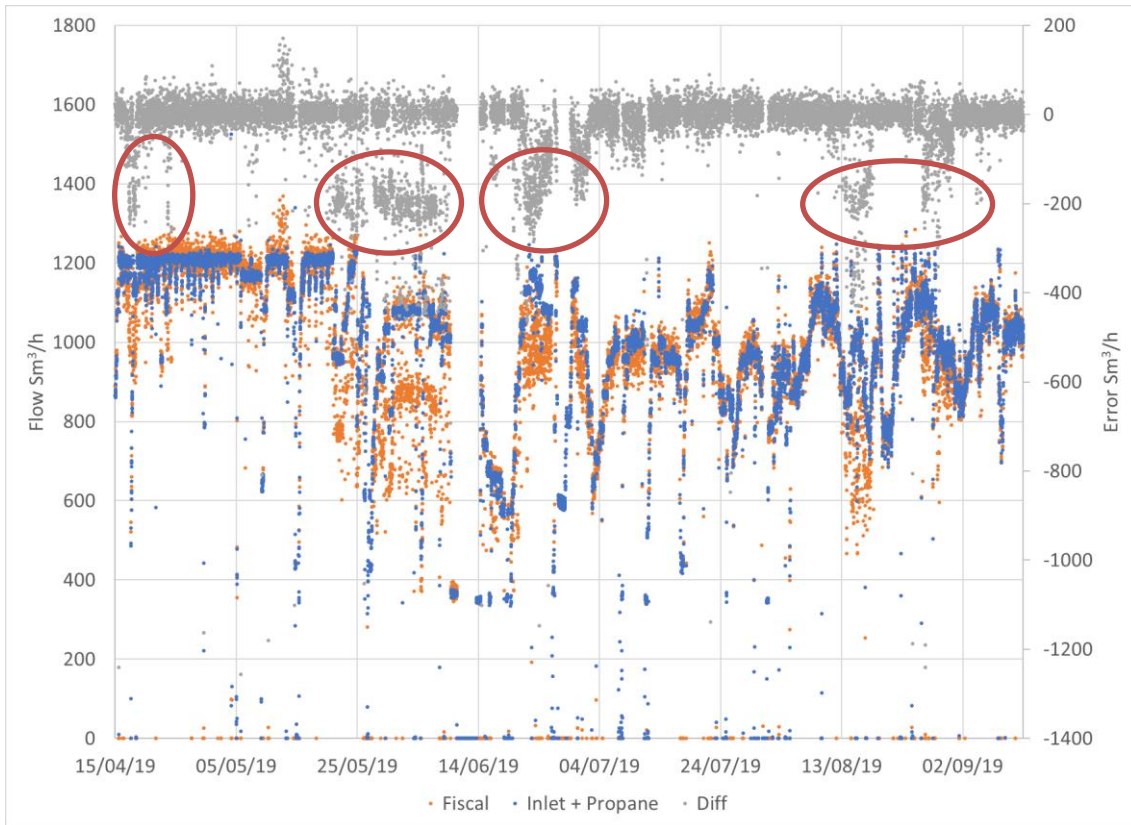


Figure 3 - Error Period (April to September 2019)

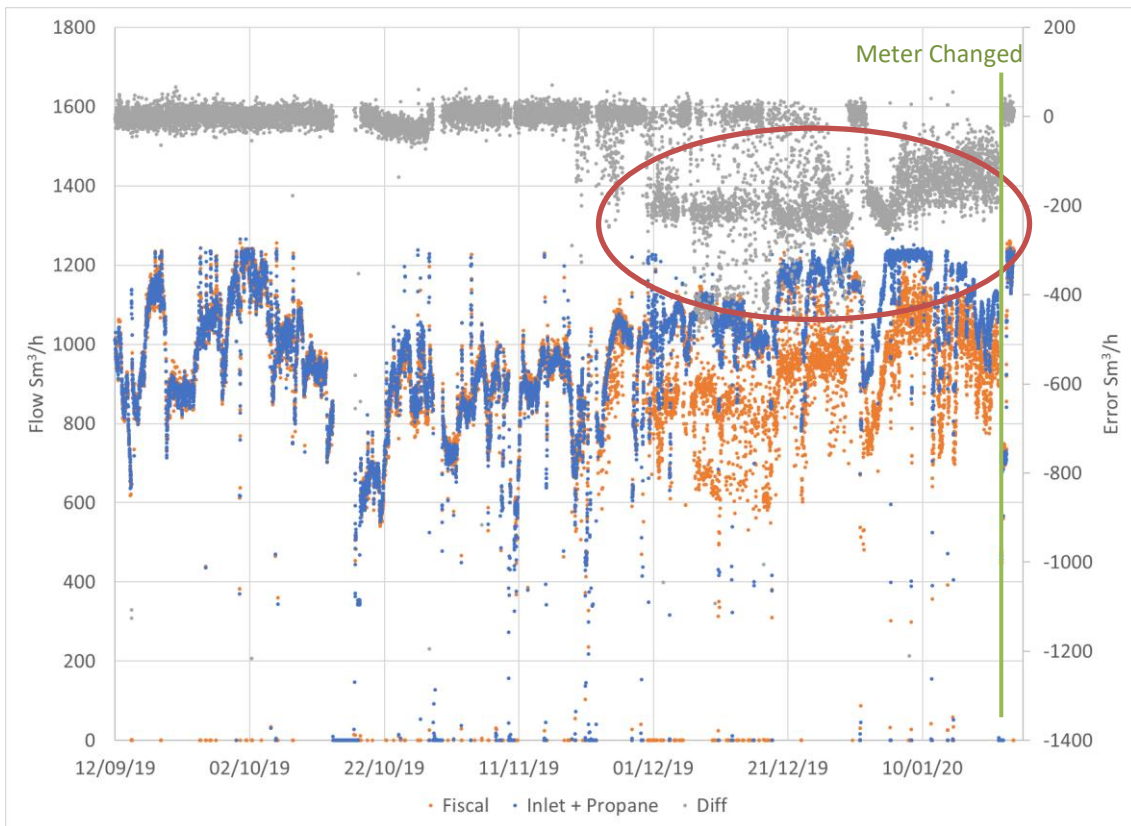


Figure 4 - Error Period (September 2019 to January 2020)

5 Error Quantification

The error due to the meter fault is estimated to be an under-registration of 299,871 Sm³. The additional error due to the erroneous Gemini data is estimated to be an under-registration of 17,538 Sm³. Therefore, the total error is estimated to be an under-registration of 317,409 Sm³, which should be reconciled using the daily correction factors (DCF) in Appendix A.

6 Learning

It is recommended that meter index head total readings are recorded as part of the annual T/PR/ME/2 validation (or monthly maintenance) and compared to the 'As Found' and 'As Left' flow computer totals.

It may be prudent to introduce logic into the system to detect large consistent discrepancies between the Inlet Meter and Fiscal Meter when gas is flowing into the network.

7 References

Howdon Site Data Files (DAT\$####.ST3 and FLO\$####.ST3)

Howdon SCADA Data Files

Gemini Daily Volumes

MER_NO016_Howdon_Data.xlsx – Calculation Data spreadsheet

8 Appendix A – Daily Correction Factors

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

Gas Day	Gemini Dvol	DCF
27-Mar-19	0.00883	0.915289
...		
16-Apr-19	0.02775	1.022176
17-Apr-19	0.02241	1.107894
18-Apr-19	0.02631	1.044957
19-Apr-19	0.02822	1
20-Apr-19	0.02813	1
21-Apr-19	0.02798	1
22-Apr-19	0.02756	1
23-Apr-19	0.02742	1.026847
24-Apr-19	0.02860	1
25-Apr-19	0.02909	1
26-Apr-19	0.02885	1
27-Apr-19	0.02684	1
28-Apr-19	0.02888	1
29-Apr-19	0.02549	1
30-Apr-19	0.02887	1
01-May-19	0.02862	1
02-May-19	0.02863	1
03-May-19	0.02894	1
04-May-19	0.02573	1
05-May-19	0.02806	1
06-May-19	0.02794	1
07-May-19	0.02807	1
08-May-19	0.02482	1
09-May-19	0.01994	1
10-May-19	0.02758	1
11-May-19	0.02922	1
12-May-19	0.02887	1
13-May-19	0.02501	1
14-May-19	0.00790	1
15-May-19	0.02120	1
16-May-19	0.02824	1
17-May-19	0.02816	1
18-May-19	0.02859	1
19-May-19	0.02880	1
20-May-19	0.02730	1.025353
21-May-19	0.02098	1.148406
22-May-19	0.02246	1.089796
23-May-19	0.02589	1.074959
24-May-19	0.02459	1.090621

Gas Day	Gemini Dvol	DCF
25-May-19	0.01924	1.065892
26-May-19	0.00450	1.031653
27-May-19	0.01420	1.106725
28-May-19	0.02054	1.086020
29-May-19	0.02052	1.135677
30-May-19	0.01854	1.208900
31-May-19	0.02237	1.133117
01-Jun-19	0.02231	1.128761
02-Jun-19	0.02290	1.153791
03-Jun-19	0.01714	1.143700
04-Jun-19	0.01885	1.154023
05-Jun-19	0.02109	1.207070
06-Jun-19	0.02244	1.120347
07-Jun-19	0.02094	1.125377
08-Jun-19	0.02236	1.056153
09-Jun-19	0.01174	1
10-Jun-19	0.00215	1
11-Jun-19	0.00000	1
12-Jun-19	0.00000	1
13-Jun-19	0.00000	1
14-Jun-19	0.01659	1
15-Jun-19	0.00496	1.036144
16-Jun-19	0.01513	1.043311
17-Jun-19	0.01482	1
18-Jun-19	0.00213	1
19-Jun-19	0.01212	1.042398
20-Jun-19	0.02085	1.076774
21-Jun-19	0.02345	1.118093
22-Jun-19	0.02255	1.185215
23-Jun-19	0.02165	1.146972
24-Jun-19	0.02306	1.111925
25-Jun-19	0.02306	0.841982
26-Jun-19	0.01006	1.030771
27-Jun-19	0.00000	1
28-Jun-19	0.00001	1
29-Jun-19	0.02468	1.069978
30-Jun-19	0.02126	1.115692
01-Jul-19	0.02123	1.110551
02-Jul-19	0.01747	1.023146
03-Jul-19	0.01704	1
04-Jul-19	0.01955	1

Gas Day	Gemini Dvol	DCF
05-Jul-19	0.02244	1
06-Jul-19	0.02229	1
07-Jul-19	0.00834	1.029528
08-Jul-19	0.02319	1.021514
09-Jul-19	0.02328	1.029663
10-Jul-19	0.02319	1.034043
11-Jul-19	0.00596	1.030807
12-Jul-19	0.02203	1
13-Jul-19	0.02341	1
14-Jul-19	0.02352	1
15-Jul-19	0.02320	1
16-Jul-19	0.02286	1
17-Jul-19	0.01062	1
18-Jul-19	0.02375	1
19-Jul-19	0.02495	1
20-Jul-19	0.02481	1
21-Jul-19	0.02649	1
22-Jul-19	0.02301	1
23-Jul-19	0.02103	1
24-Jul-19	0.01485	1
25-Jul-19	0.00996	1
26-Jul-19	0.01947	1
27-Jul-19	0.02210	1
28-Jul-19	0.02312	1
29-Jul-19	0.01904	1
30-Jul-19	0.01549	1
31-Jul-19	0.00601	1
01-Aug-19	0.01854	1
02-Aug-19	0.02064	1
03-Aug-19	0.01651	1
04-Aug-19	0.01991	1
05-Aug-19	0.02139	1
06-Aug-19	0.02282	1
07-Aug-19	0.02446	1
08-Aug-19	0.02640	1
09-Aug-19	0.02491	1
10-Aug-19	0.02600	1
11-Aug-19	0.02496	1
12-Aug-19	0.02333	1
13-Aug-19	0.01998	1.062294
14-Aug-19	0.01856	1.180990
15-Aug-19	0.01651	1.172025
16-Aug-19	0.01797	1.172716
17-Aug-19	0.01827	1.073850
18-Aug-19	0.02192	1
19-Aug-19	0.02090	1
20-Aug-19	0.01860	1

Gas Day	Gemini Dvol	DCF
21-Aug-19	0.02136	1
22-Aug-19	0.01805	1
23-Aug-19	0.02547	1
24-Aug-19	0.01441	1
25-Aug-19	0.02415	1
26-Aug-19	0.02304	1.090289
27-Aug-19	0.02098	1.060053
28-Aug-19	0.02130	1.070807
29-Aug-19	0.02277	1.042040
30-Aug-19	0.02191	1.069931
31-Aug-19	0.02164	1
01-Sep-19	0.02047	1
02-Sep-19	0.02202	1
03-Sep-19	0.02465	1
04-Sep-19	0.02353	1.027354
05-Sep-19	0.02556	1
06-Sep-19	0.02598	1
07-Sep-19	0.02034	1
08-Sep-19	0.02055	1
09-Sep-19	0.02459	1
10-Sep-19	0.02487	1
11-Sep-19	0.02452	1
12-Sep-19	0.02280	1
13-Sep-19	0.01990	1
14-Sep-19	0.01779	1
15-Sep-19	0.02150	1
16-Sep-19	0.02511	1
17-Sep-19	0.02714	1
18-Sep-19	0.02596	1
19-Sep-19	0.02174	1
20-Sep-19	0.02149	1
21-Sep-19	0.02092	1
22-Sep-19	0.02115	1
23-Sep-19	0.02214	1
24-Sep-19	0.02394	1
25-Sep-19	0.02410	1
26-Sep-19	0.02578	1
27-Sep-19	0.02396	1
28-Sep-19	0.02496	1
29-Sep-19	0.02688	1
30-Sep-19	0.02663	1
01-Oct-19	0.02789	1
02-Oct-19	0.02644	1
03-Oct-19	0.02771	1
04-Oct-19	0.02607	1
05-Oct-19	0.02215	1
06-Oct-19	0.02396	1

Gas Day	Gemini Dvol	DCF
07-Oct-19	0.02448	1
08-Oct-19	0.02290	1
09-Oct-19	0.02431	1
10-Oct-19	0.02290	1
11-Oct-19	0.02253	1
12-Oct-19	0.02237	1
13-Oct-19	0.01935	1
14-Oct-19	0.00371	1
15-Oct-19	0.00000	1
16-Oct-19	0.00000	1
17-Oct-19	0.00079	1.020459
18-Oct-19	0.01064	1
19-Oct-19	0.01579	1
20-Oct-19	0.01584	1
21-Oct-19	0.01482	1.040844
22-Oct-19	0.01937	1.033919
23-Oct-19	0.02092	1.032774
24-Oct-19	0.02154	1.028531
25-Oct-19	0.02213	1.038257
26-Oct-19	0.02072	1.046217
27-Oct-19	0.02160	1.036530
28-Oct-19	0.01934	1
29-Oct-19	0.00112	1
30-Oct-19	0.01099	1
31-Oct-19	0.01734	1
01-Nov-19	0.01802	1
02-Nov-19	0.01998	1
03-Nov-19	0.01950	1
04-Nov-19	0.02156	1
05-Nov-19	0.02245	1
06-Nov-19	0.01943	1
07-Nov-19	0.02004	1
08-Nov-19	0.01251	1
09-Nov-19	0.00707	1
10-Nov-19	0.01229	1
11-Nov-19	0.02186	1
12-Nov-19	0.02100	1
13-Nov-19	0.02149	1
14-Nov-19	0.01668	1
15-Nov-19	0.02270	1
16-Nov-19	0.02330	1
17-Nov-19	0.02239	1
18-Nov-19	0.01621	1
19-Nov-19	0.01595	1.035877
20-Nov-19	0.01535	1.037313
21-Nov-19	0.00427	1
22-Nov-19	0.01308	1.020176

Gas Day	Gemini Dvol	DCF
23-Nov-19	0.02016	1.027358
24-Nov-19	0.02285	1.041994
25-Nov-19	0.02408	1.057365
26-Nov-19	0.02462	1
27-Nov-19	0.02112	1
28-Nov-19	0.02143	1
29-Nov-19	0.01696	1.047143
30-Nov-19	0.01699	1.110414
01-Dec-19	0.01709	1.200831
02-Dec-19	0.02002	1.192010
03-Dec-19	0.01870	1.170993
04-Dec-19	0.02193	1.086375
05-Dec-19	0.02198	1.053540
06-Dec-19	0.02157	1.170029
07-Dec-19	0.02183	1.226296
08-Dec-19	0.02030	1.332772
09-Dec-19	0.02030	1.211160
10-Dec-19	0.01758	1.295599
11-Dec-19	0.02045	1.144882
12-Dec-19	0.01719	1.195102
13-Dec-19	0.02238	1.103613
14-Dec-19	0.02061	1.125610
15-Dec-19	0.01853	1.121424
16-Dec-19	0.02217	1.057349
17-Dec-19	0.01703	1.381332
18-Dec-19	0.01771	1.173072
19-Dec-19	0.01771	1.522352
20-Dec-19	0.01771	1.595014
21-Dec-19	0.01771	1.580930
22-Dec-19	0.01771	1.466374
23-Dec-19	0.01771	1.445900
24-Dec-19	0.02389	1.185948
25-Dec-19	0.02422	1.180080
26-Dec-19	0.02301	1.194611
27-Dec-19	0.02323	1.276833
28-Dec-19	0.02278	1.251382
29-Dec-19	0.02423	1.198388
30-Dec-19	0.02722	1.020311
31-Dec-19	0.02302	1.021275
01-Jan-20	0.01923	1.148582
02-Jan-20	0.01922	1.243631
03-Jan-20	0.02083	1.244345
04-Jan-20	0.02341	1.239287
05-Jan-20	0.02199	1.211630
06-Jan-20	0.02549	1.154190
07-Jan-20	0.02490	1.118129
08-Jan-20	0.02317	1.157036

Gas Day	Gemini Dvol	DCF
09-Jan-20	0.02578	1.137981
10-Jan-20	0.02573	1.132057
11-Jan-20	0.01902	1.141258
12-Jan-20	0.02051	1.178399
13-Jan-20	0.02221	1.146248
14-Jan-20	0.02012	1.155837
15-Jan-20	0.02525	1.132025

Gas Day	Gemini Dvol	DCF
16-Jan-20	0.02415	1.125384
17-Jan-20	0.02328	1.128702
18-Jan-20	0.02227	1.139977
19-Jan-20	0.02129	1.145660
20-Jan-20	0.02344	1.132021
21-Jan-20	0.00985	1.051856