



ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT SAMLESBURY

A Report for

**National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA**

PROJECT NO: NGR010

REPORT NO: 2010/235

DATE: 16 JUNE 2010



This report is issued as part of the contract under which the work has been carried out for the client.

NOTES

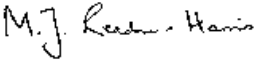
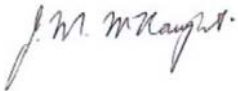
- 1** This report may be published in full by the client unless it includes information supplied in confidence by TUV NEL Ltd or any third party. Such information, if included within the report, shall be identified as confidential by TUV NEL Ltd.
- 2a** The prior written consent of TUV NEL Ltd shall be obtained by the client before publication by them of any extract from, or abridgement of, this report.
- 2b** The prior written consent of TUV NEL Ltd shall be obtained by the client before publication:
- Where such publication is made in connection with any public enquiry, legal proceedings or arbitration.
 - Where such publication is made in connection with any company prospectus or similar document.
 - Where the client has notice that TUV NEL Ltd is seeking or intends to seek patent or like protection for any intellectual property produced in the course of rendering the services.

TUV NEL Ltd
East Kilbride
GLASGOW G75 0QF
UK
Tel: +44 (0)1355 220222
Fax: +44 (0)1355 272999
www.tuvnel.com

Assessment of Error Due to Orifice Diameter Mis-Measurement at Samlesbury

A Report for

National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA

Prepared by: 	Approved by: 
Dr M J Reader-Harris	J M McNaught

for
Michael Valente
Managing Director

Date: 16 June 2010

EXECUTIVE SUMMARY

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors.

At Samlesbury a correction factor of 1.002084 should be applied during the period of mis-measurement.

Over the period 22/08/2007 to 26/08/2008 inclusive the flow was 1193.63311 mscm and the corrected flow should be 1196.12049 mscm.

CONTENTS

	Page No
EXECUTIVE SUMMARY	2
1 INTRODUCTION	4
2 ORIFICE DIAMETERS	4
3 CORRECTING THE FLOWRATE	5
4 CORRECTIONS ON A DAILY BASIS	6
5 CONCLUSIONS	6
APPENDIX A ORIFICE PLATE CALIBRATION CERTIFICATES	7
APPENDIX B CORRECTED DAILY VOLUME FLOWS	13

1 INTRODUCTION

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors. This report covers the flows through Samlesbury in the period of the error. The Joint Office Error Code is NW006.

2 ORIFICE DIAMETERS

The calibrations of the orifice plates in question gave the measured diameters shown in Table 1. The diameters at 20 °C have been calculated.

TABLE 1
ORIFICE DIAMETERS

Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature	Value at 20 °C Orifice bore (mm)
OP5003	229	30/03/2005	358.0860	21	358.0803
OP50166	229	27/07/2005	358.0910	21	358.0853
OP50201	229-1	29/06/2006	358.0440	21	358.0383
OP60146	229	28/12/2006	358.1130	21	358.1073
OP80026	229-1	13/06/2008	358.0450	20	358.0450
OP80069	229	08/10/2008	358.4275	20	358.4275

Figure 1 shows the data from Table 1 for the orifice bores at 20°C. The first two calibrations of plate 229 have been ignored because of the work that was carried out. Therefore this figure shows that there is a low measurement followed by a high measurement of diameter. The deduction from this graph is that a plate was mis-measured. From the experience of other sets of measurements it is the low measurement that is in error.

The calibration certificates for the orifice plates are given as Appendix A.

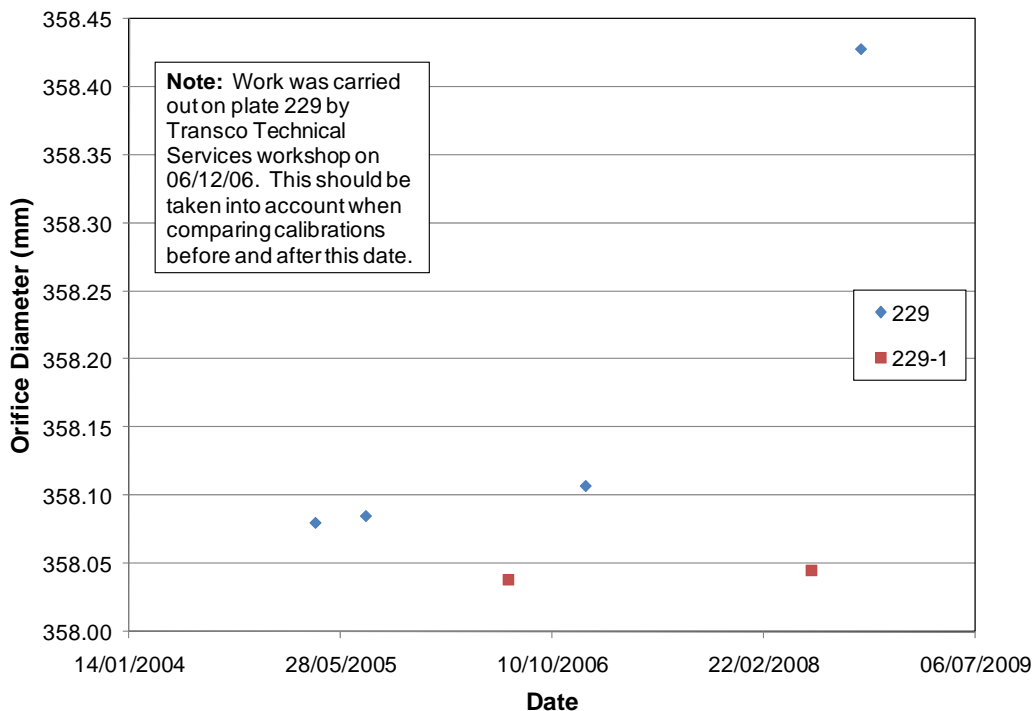


Figure 1 Orifice Diameters at 20 °C

The plates actually used in the meter tube are given in Table 2.

TABLE 2

PLATES USED IN EACH LINE AS CONFIGURED BY THE FLOW COMPUTER

Configuration	omnM0815.cfg	omnM0822.cfg	omnN0826.cfg
	15/08/2007 23:01	22/08/2007 23:01	26/08/2008 23:01
Orifice plate bore diameter (mm)	358.044	358.113	358.045
Expansion coefficient of the plate (1/°C)	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	20
Meter tube diameter (mm)	581.0758	581.0758	581.0758
Expansion coefficient of the meter tube (1/°C)	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20
Isentropic Exponent	1.3263	1.3261	1.3294
Dynamic Viscosity (Pa.s)	0.000012	0.0000119	0.0000117
Orifice plate certificate number	OP50201	OP60146	OP80026
Orifice plate serial number	229-1	229	229-1
Error in orifice diameter?	No	Yes	No

3 CORRECTING THE FLOWRATE

To correct the measured flowrate by replacing an incorrect diameter with the correct diameter might appear to be fairly straightforward. However, the data supplied only give time to the nearest minute and at four-minute intervals. This is inadequate for very accurate calculation. It is possible to calculate the flow over each time interval and to add the values over a day; this method can be used to check that the calculations are being done correctly, but the differences between the summed figures and the ones already given in the spreadsheet are too large to enable the correction to be calculated in this way. An alternative method has therefore been used.

The mass flowrate q_m is given by

$$q_m = \frac{\pi d^2 C \varepsilon \sqrt{2\rho\Delta p}}{4\sqrt{1-\beta^4}}$$

where d is the orifice diameter, C is the discharge coefficient, ε is the expansibility, ρ is the density, Δp is the differential pressure, and β is the diameter ratio.

If the corrected and original data are described with subscripts c and o , then the following correction factor is obtained:

$$\frac{q_{m,c}}{q_{m,o}} = \left(\frac{d_c}{d_o}\right)^2 \frac{C_c \varepsilon_c \sqrt{1-\beta_o^4}}{C_o \varepsilon_o \sqrt{1-\beta_c^4}}$$

The correct effective diameter is taken as the average of the measurements shown in Table 1 for that plate excluding the erroneous measurement. It is then necessary to calculate C and ε in each case, and they were determined from the equations in ISO 5167-1:1991. C is a function of β and Re_D ; so there is a change in C due to β , but the change varies with Reynolds number. Throughout the calculations the upstream pressure p_1 is taken as 52 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00003% at maximum.

Over the period from 22/08/2007 to 26/08/2008 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 581.0758 mm, the isentropic exponent is 1.3261 and the dynamic viscosity 0.0000119 Pa s.

TABLE 3
THE CORRECTION FROM 22/08/2007 TO 26/08/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	358.1073	0.616283	0.999933	3692150	0.604004	
Corrected $\Delta p=10$ mbar	358.4275	0.616834	0.999933	3699848	0.604000	1.0020848
Original $\Delta p=500$ mbar	358.1073	0.616283	0.996661	26011254	0.603755	
Corrected $\Delta p=500$ mbar	358.4275	0.616834	0.996660	26065442	0.603750	1.0020833

So $q_{m,c}/q_{m,o}$ is 1.002084.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 22/08/2007 to 26/08/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 11:00; therefore 45.9% of the flow for 22/08/2007 has to be corrected and 49.1% of that for 26/08/2008. Summing the data gives the figures in Table 4.

TABLE 4
THE FLOW OVER THE PERIOD 22/08/2007 TO 26/08/2008 INCLUSIVE

Flow (mscm)	1193.63311
Correction (mscm)	2.48738
Corrected flow (mscm)	1196.12049
% change	0.2084

5 CONCLUSIONS

A correction factor of 1.002084 should be applied during the period of mis-measurement.

APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES
TRANSCO ORIFICE PLATE CALIBRATION

DATE: 30-03-05

REF NO: OP5003

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 358.086mm

PLATE DETAILS

PLATE SERIAL.	229	PLATE O.D	647.772mm	SITE:	SALMESBURY
MANUFACTURER:		PIPE I.D:	mm	FLOW:	
MATERIAL CERT.No		DESIGN BORE	mm		

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 15/10/05

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	1	2	4	6	7	8		
FLATNESS %	0.037	0.045	0.045	0.038	0.038	0.042	0.042	0.025
'E mm	11.850	11.949	11.938	11.933	12.021	11.807	11.510	11.560
'E mm	8.579	8.712	8.832	8.804	8.746	8.624	8.522	8.480
EDGE SHARPNESS mm	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
BEVEL ANGLE	36 DEGS							
CONCENTRICITY	0.012mm							
SURFACE FINISH (Ra)	4.4 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS :	0.022mm	TAPER	0 degs					

COMMENTS

INSPECTED BY..



G. WARDLE

VERIFIED BY



P. KENNERSON

TRANSCO ORIFICE PLATE CALIBRATION

DATE: 27-07-05
REF NO: OP50166
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 358.091mm

PLATE DETAILS

PLATE SERIAL. 229 PLATE O.D 647.767mm
 MANUFACTURER: PIPE I.D: 581.329mm SITE: SALMESBURY
 MATERIAL CERT.No DESIGN BORE: 358.038mm FLOW:

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 15/10/05

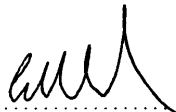
UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.045	0.031	0.036	0.045	0.027	0.014	0.050	0.024
E' mm	11.851	11.943	11.936	11.943	12.003	11.791	11.502	11.536
e' mm	8.568	8.693	8.826	8.824	8.761	8.619	8.505	8.461
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.025	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	36 DEGS							
CONCENTRICITY	0.015mm							
SURFACE FINISH (Ra)	3.7 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.010mm TAPER: 0 degs

COMMENTS:

INSPECTED BY  G. WARDLE

VERIFIED BY  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 29-06-06
REF NO: OP50201
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 358.044mm

PLATE DETAILS

PLATE SERIAL.	229-1	PLATE O.D	647.716mm		
MANUFACTURER:	HEECO	PIPE I.D:	581.329mm	SITE:	SALMESBURY
MATERIAL CERT.No.		DESIGN BORE	358.038mm	FLOW:	

TEST EQUIPMENT

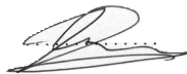
MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 14/10/06

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS μ	0.051	0.066	0.053	0.066	0.063	0.078	0.017	0.017
'E' mm	12.690	12.672	12.673	12.678	12.678	12.674	12.677	12.690
ϕ mm	9.062	9.035	9.096	9.095	9.166	9.167	9.162	9.143
EDGE SHARPNESS mm	0.0125	0.0125	0.025	0.0125	0.025	0.025	0.05	0.0125
BEVEL ANGLE	37 DEGS							
CONCENTRICITY	0.071mm							
SURFACE FINISH (Ra)	1.3 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS :	0.012mm	TAPER:	0 degs					

COMMENTS

INSPECTED BY.



P. KENNERSON



NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 28-12-06
REF NO: OP60146
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 358.113mm

PLATE DETAILS

PLATE SERIAL. 229 PLATE O.D 647.237mm
 MANUFACTURER: PIPE I.D: 581.329mm SITE: SALMESBURY
 MATERIAL CERT.No DESIGN BORE: 358.038mm FLOW:


TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 13/10/07

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4				
PLATNESS %	0.050	0.036	0.031	0.018	0.016	0.007	0.031	0.049
'E' mm	11.601	11.568	11.540	11.587	11.740	11.609	11.391	11.409
e' mm	8.558	8.540	8.614	8.674	8.706	8.642	8.617	8.597
EDGE SHARPNESS mm	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
BEVEL ANGLE	36 DEGS							
CONCENTRICITY	0.025mm							
SURFACE FINISH (Ra)	1.3 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.352mm	TAPER: 0 degs						

COMMENTS

INSPECTED BY:  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-JUNE-2008
REF NO: OP80026
TEMPERATURE: 20 degsC
MEASURED ORIFICE BORE: 358.045mm

PLATE DETAILS

PLATE SERIAL. 229-1 PLATE O.D 647.727mm
 MANUFACTURER: HEECO PIPE I.D: 581.0785mm SITE: SALMESBURY
 MATERIAL CERT.No DESIGN BORE 358.038mm FLOW: M³/DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 6292 NEXT CAL DUE:- 05-OCTOBER-2008

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	4	5	7			
FLATNESS %	0.042	0.083	0.077	0.092	0.069	0.039	0.018	0.015
'E' mm	12.679	12.647	12.663	12.678	12.685	12.665	12.676	12.680
'e' mm	9.048	9.044	9.083	9.103	9.181	9.179	9.153	9.101
EDGE SHARPNESS mm	0.025	0.025	0.0375	0.025	0.025	0.0125	0.025	
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.074mm							
SURFACE FINISH (Ra)	0.9 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS :	0.015mm	TAPER:	0 degs					

COMMENTS: LIGHT GREASE ON PLATE

INSPECTED BY:  M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 08-OCT-2008
 REF NO: OP80069
 TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 358.4275mm

PLATE DETAILS

PLATE SERIAL. 229 PLATE O.D. 647.774mm
 MANUFACTURER: PIPE I.D: 581.0785mm SITE SALMESBURY
 MATERIAL CERT.No DESIGN BORE 358.038mm FLOW M³/DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6822. NEXT CAL DUE:- 03-OCTOBER-2009

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	2	3					
FLATNESS %	0.059	0.042	0.02	0.023	0.007	0.008	0.004
E mm	11.556	11.591	563	11.530	11.669	11.580	11.399
	8.561	8.557	8.638	8.647	8.662	8.655	8.598
EDGE SHARPNESS mm	0.025	0.025	0.025	0.025	0.025	0.025	0.025
BEVEL ANGLE	37 DEGS						
CONCENTRICITY	0.027mm						
SURFACE FINISH (Ra)	1.0 microns						
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS						
ROUNDNESS 0.005mm	TAPER 0 degs						

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: CLEAN PLATE

INSPECTED BY:  M Livingstone

APPENDIX B CORRECTED DAILY VOLUME FLOWS

TABLE B.1

FLOWS AT SAMLESBURY DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
22-Aug-07	0.08400	0.08408	0.0956
23-Aug-07	0.07201	0.07216	0.2084
24-Aug-07	0.10400	0.10422	0.2084
25-Aug-07	0.00000	0.00000	0.0000
26-Aug-07	0.00000	0.00000	0.0000
27-Aug-07	0.00000	0.00000	0.0000
28-Aug-07	0.00000	0.00000	0.0000
29-Aug-07	0.00000	0.00000	0.0000
30-Aug-07	0.00000	0.00000	0.0000
31-Aug-07	0.27900	0.27958	0.2084
01-Sep-07	0.00000	0.00000	0.0000
02-Sep-07	0.00000	0.00000	0.0000
03-Sep-07	0.00000	0.00000	0.0000
04-Sep-07	0.00000	0.00000	0.0000
05-Sep-07	0.00000	0.00000	0.0000
06-Sep-07	0.00000	0.00000	0.0000
07-Sep-07	0.00000	0.00000	0.0000
08-Sep-07	0.00000	0.00000	0.0000
09-Sep-07	0.00000	0.00000	0.0000
10-Sep-07	0.00000	0.00000	0.0000
11-Sep-07	0.88100	0.88284	0.2084
12-Sep-07	0.00000	0.00000	0.0000
13-Sep-07	0.00000	0.00000	0.0000
14-Sep-07	0.00000	0.00000	0.0000
15-Sep-07	0.00000	0.00000	0.0000
16-Sep-07	0.00000	0.00000	0.0000
17-Sep-07	0.00000	0.00000	0.0000
18-Sep-07	0.50100	0.50204	0.2084
19-Sep-07	0.00000	0.00000	0.0000
20-Sep-07	0.00000	0.00000	0.0000
21-Sep-07	0.00000	0.00000	0.0000
22-Sep-07	0.00000	0.00000	0.0000
23-Sep-07	0.00000	0.00000	0.0000
24-Sep-07	0.00000	0.00000	0.0000
25-Sep-07	0.00000	0.00000	0.0000
26-Sep-07	0.00000	0.00000	0.0000
27-Sep-07	3.62500	3.63255	0.2084
28-Sep-07	3.03101	3.03733	0.2084
29-Sep-07	3.85400	3.86203	0.2084

30-Sep-07	4.00100	4.00934	0.2084
01-Oct-07	2.99001	2.99624	0.2084
02-Oct-07	0.00000	0.00000	0.0000
03-Oct-07	0.00000	0.00000	0.0000
04-Oct-07	0.17500	0.17536	0.2084
05-Oct-07	0.72100	0.72250	0.2084
06-Oct-07	0.00000	0.00000	0.0000
07-Oct-07	0.00000	0.00000	0.0000
08-Oct-07	0.00000	0.00000	0.0000
09-Oct-07	0.18800	0.18839	0.2084
10-Oct-07	0.00000	0.00000	0.0000
11-Oct-07	0.00000	0.00000	0.0000
12-Oct-07	0.00000	0.00000	0.0000
13-Oct-07	0.00000	0.00000	0.0000
14-Oct-07	0.00000	0.00000	0.0000
15-Oct-07	0.00000	0.00000	0.0000
16-Oct-07	3.13100	3.13753	0.2084
17-Oct-07	3.24600	3.25276	0.2084
18-Oct-07	0.83700	0.83874	0.2084
19-Oct-07	3.77100	3.77886	0.2084
20-Oct-07	4.41000	4.41919	0.2084
21-Oct-07	4.67000	4.67973	0.2084
22-Oct-07	3.80100	3.80892	0.2084
23-Oct-07	4.93200	4.94228	0.2084
24-Oct-07	4.87201	4.88216	0.2084
25-Oct-07	5.39200	5.40324	0.2084
26-Oct-07	5.62199	5.63371	0.2084
27-Oct-07	3.85201	3.86004	0.2084
28-Oct-07	3.87799	3.88607	0.2084
29-Oct-07	3.68401	3.69169	0.2084
30-Oct-07	3.97800	3.98629	0.2084
31-Oct-07	4.08800	4.09652	0.2084
01-Nov-07	4.03201	4.04041	0.2084
02-Nov-07	4.01799	4.02636	0.2084
03-Nov-07	4.27301	4.28191	0.2084
04-Nov-07	4.70900	4.71881	0.2084
05-Nov-07	4.72499	4.73484	0.2084
06-Nov-07	4.75600	4.76591	0.2084
07-Nov-07	4.53601	4.54546	0.2084
08-Nov-07	5.32899	5.34010	0.2084
09-Nov-07	4.12401	4.13260	0.2084
10-Nov-07	3.78900	3.79690	0.2084
11-Nov-07	4.04900	4.05744	0.2084
12-Nov-07	5.07600	5.08658	0.2084
13-Nov-07	6.05899	6.07162	0.2084
14-Nov-07	5.97800	5.99046	0.2084
15-Nov-07	7.13701	7.15188	0.2084
16-Nov-07	8.80099	8.81933	0.2084

17-Nov-07	5.97701	5.98947	0.2084
18-Nov-07	7.69101	7.70704	0.2084
19-Nov-07	8.29700	8.31429	0.2084
20-Nov-07	6.98398	6.99853	0.2084
21-Nov-07	7.51001	7.52566	0.2084
22-Nov-07	7.73502	7.75114	0.2084
23-Nov-07	8.41299	8.43052	0.2084
24-Nov-07	7.85199	7.86835	0.2084
25-Nov-07	6.93402	6.94847	0.2084
26-Nov-07	7.53598	7.55168	0.2084
27-Nov-07	6.99500	7.00958	0.2084
28-Nov-07	5.80200	5.81409	0.2084
29-Nov-07	6.63300	6.64682	0.2084
30-Nov-07	6.18701	6.19990	0.2084
01-Dec-07	5.97202	5.98447	0.2084
02-Dec-07	6.04498	6.05758	0.2084
03-Dec-07	7.20200	7.21701	0.2084
04-Dec-07	7.27902	7.29419	0.2084
05-Dec-07	5.97400	5.98645	0.2084
06-Dec-07	5.96500	5.97743	0.2084
07-Dec-07	6.65399	6.66786	0.2084
08-Dec-07	6.20300	6.21593	0.2084
09-Dec-07	6.81400	6.82820	0.2084
10-Dec-07	8.67300	8.69107	0.2084
11-Dec-07	8.97000	8.98869	0.2084
12-Dec-07	7.44400	7.45951	0.2084
13-Dec-07	7.91400	7.93049	0.2084
14-Dec-07	9.08200	9.10093	0.2084
15-Dec-07	11.33499	11.35861	0.2084
16-Dec-07	9.15701	9.17609	0.2084
17-Dec-07	9.82401	9.84448	0.2084
18-Dec-07	8.75299	8.77123	0.2084
19-Dec-07	8.73499	8.75319	0.2084
20-Dec-07	10.46700	10.48881	0.2084
21-Dec-07	10.47400	10.49583	0.2084
22-Dec-07	10.23200	10.25332	0.2084
23-Dec-07	9.86401	9.88457	0.2084
24-Dec-07	7.46002	7.47557	0.2084
25-Dec-07	8.32898	8.34634	0.2084
26-Dec-07	5.88397	5.89623	0.2084
27-Dec-07	6.00702	6.01954	0.2084
28-Dec-07	4.98999	5.00039	0.2084
29-Dec-07	4.96802	4.97837	0.2084
30-Dec-07	5.75702	5.76902	0.2084
31-Dec-07	6.25897	6.27201	0.2084
01-Jan-08	5.60901	5.62070	0.2084
02-Jan-08	6.17798	6.19085	0.2084
03-Jan-08	7.56799	7.58376	0.2084

04-Jan-08	8.37604	8.39350	0.2084
05-Jan-08	7.53302	7.54872	0.2084
06-Jan-08	7.96997	7.98658	0.2084
07-Jan-08	6.99402	7.00860	0.2084
08-Jan-08	8.44000	8.45759	0.2084
09-Jan-08	8.66901	8.68708	0.2084
10-Jan-08	8.15796	8.17496	0.2084
11-Jan-08	8.58801	8.60591	0.2084
12-Jan-08	8.96002	8.97869	0.2084
13-Jan-08	6.34399	6.35721	0.2084
14-Jan-08	7.54999	7.56572	0.2084
15-Jan-08	7.07397	7.08871	0.2084
16-Jan-08	6.82904	6.84327	0.2084
17-Jan-08	8.34796	8.36536	0.2084
18-Jan-08	6.06403	6.07667	0.2084
19-Jan-08	5.98401	5.99648	0.2084
20-Jan-08	5.76300	5.77501	0.2084
21-Jan-08	6.08197	6.09464	0.2084
22-Jan-08	8.63501	8.65301	0.2084
23-Jan-08	7.60004	7.61588	0.2084
24-Jan-08	7.55701	7.57276	0.2084
25-Jan-08	7.54498	7.56070	0.2084
26-Jan-08	7.62396	7.63985	0.2084
27-Jan-08	7.50104	7.51667	0.2084
28-Jan-08	7.43896	7.45446	0.2084
29-Jan-08	7.68604	7.70206	0.2084
30-Jan-08	8.09302	8.10989	0.2084
31-Jan-08	8.51495	8.53270	0.2084
01-Feb-08	8.14203	8.15900	0.2084
02-Feb-08	7.82300	7.83930	0.2084
03-Feb-08	7.46997	7.48554	0.2084
04-Feb-08	7.18500	7.19997	0.2084
05-Feb-08	8.05804	8.07483	0.2084
06-Feb-08	6.83398	6.84822	0.2084
07-Feb-08	6.90802	6.92242	0.2084
08-Feb-08	5.07800	5.08858	0.2084
09-Feb-08	7.29895	7.31416	0.2084
10-Feb-08	6.05603	6.06865	0.2084
11-Feb-08	6.23499	6.24798	0.2084
12-Feb-08	6.56000	6.57367	0.2084
13-Feb-08	6.95300	6.96749	0.2084
14-Feb-08	7.01202	7.02663	0.2084
15-Feb-08	7.04401	7.05869	0.2084
16-Feb-08	7.62201	7.63789	0.2084
17-Feb-08	7.25897	7.27410	0.2084
18-Feb-08	7.11200	7.12682	0.2084
19-Feb-08	7.90802	7.92450	0.2084
20-Feb-08	9.12500	9.14402	0.2084

21-Feb-08	7.70697	7.72303	0.2084
22-Feb-08	6.92102	6.93544	0.2084
23-Feb-08	6.51898	6.53257	0.2084
24-Feb-08	6.94800	6.96248	0.2084
25-Feb-08	7.06104	7.07576	0.2084
26-Feb-08	6.89398	6.90835	0.2084
27-Feb-08	5.50500	5.51647	0.2084
28-Feb-08	4.01000	4.01836	0.2084
29-Feb-08	4.22900	4.23781	0.2084
01-Mar-08	4.61900	4.62863	0.2084
02-Mar-08	4.55300	4.56249	0.2084
03-Mar-08	4.44700	4.45627	0.2084
04-Mar-08	4.80800	4.81802	0.2084
05-Mar-08	5.14400	5.15472	0.2084
06-Mar-08	4.82400	4.83405	0.2084
07-Mar-08	4.64700	4.65668	0.2084
08-Mar-08	4.18300	4.19172	0.2084
09-Mar-08	4.46200	4.47130	0.2084
10-Mar-08	4.17900	4.18771	0.2084
11-Mar-08	4.09300	4.10153	0.2084
12-Mar-08	4.09800	4.10654	0.2084
13-Mar-08	3.94901	3.95724	0.2084
14-Mar-08	3.92699	3.93517	0.2084
15-Mar-08	3.90900	3.91715	0.2084
16-Mar-08	4.06800	4.07648	0.2084
17-Mar-08	4.02800	4.03639	0.2084
18-Mar-08	3.99200	4.00032	0.2084
19-Mar-08	3.99600	4.00433	0.2084
20-Mar-08	4.11400	4.12257	0.2084
21-Mar-08	4.16800	4.17669	0.2084
22-Mar-08	3.99400	4.00232	0.2084
23-Mar-08	3.99700	4.00533	0.2084
24-Mar-08	3.99600	4.00433	0.2084
25-Mar-08	4.42100	4.43021	0.2084
26-Mar-08	4.04700	4.05543	0.2084
27-Mar-08	4.04601	4.05444	0.2084
28-Mar-08	4.16100	4.16967	0.2084
29-Mar-08	3.87700	3.88508	0.2084
30-Mar-08	4.08800	4.09652	0.2084
31-Mar-08	4.03401	4.04242	0.2084
01-Apr-08	3.99399	4.00231	0.2084
02-Apr-08	3.93901	3.94722	0.2084
03-Apr-08	3.90700	3.91514	0.2084
04-Apr-08	3.96100	3.96925	0.2084
05-Apr-08	4.02600	4.03439	0.2084
06-Apr-08	4.33000	4.33902	0.2084
07-Apr-08	3.99899	4.00732	0.2084
08-Apr-08	4.01300	4.02136	0.2084

09-Apr-08	4.26700	4.27589	0.2084
10-Apr-08	4.01701	4.02538	0.2084
11-Apr-08	3.82500	3.83297	0.2084
12-Apr-08	3.83299	3.84098	0.2084
13-Apr-08	3.87401	3.88208	0.2084
14-Apr-08	3.75299	3.76081	0.2084
15-Apr-08	3.74901	3.75682	0.2084
16-Apr-08	4.09000	4.09852	0.2084
17-Apr-08	3.98801	3.99632	0.2084
18-Apr-08	4.36200	4.37109	0.2084
19-Apr-08	3.98700	3.99531	0.2084
20-Apr-08	4.00999	4.01835	0.2084
21-Apr-08	3.77901	3.78689	0.2084
22-Apr-08	4.20000	4.20875	0.2084
23-Apr-08	4.00301	4.01135	0.2084
24-Apr-08	3.99899	4.00732	0.2084
25-Apr-08	4.00200	4.01034	0.2084
26-Apr-08	3.31100	3.31790	0.2084
27-Apr-08	3.49600	3.50329	0.2084
28-Apr-08	3.41800	3.42512	0.2084
29-Apr-08	3.54199	3.54937	0.2084
30-Apr-08	3.99301	4.00133	0.2084
01-May-08	4.00400	4.01234	0.2084
02-May-08	4.00000	4.00834	0.2084
03-May-08	0.01401	0.01404	0.2084
04-May-08	0.00000	0.00000	0.0000
05-May-08	0.00000	0.00000	0.0000
06-May-08	0.00000	0.00000	0.0000
07-May-08	0.00000	0.00000	0.0000
08-May-08	0.00000	0.00000	0.0000
09-May-08	0.00000	0.00000	0.0000
10-May-08	0.00000	0.00000	0.0000
11-May-08	0.00000	0.00000	0.0000
12-May-08	0.00000	0.00000	0.0000
13-May-08	0.00400	0.00401	0.2084
14-May-08	0.00000	0.00000	0.0000
15-May-08	0.00000	0.00000	0.0000
16-May-08	0.06299	0.06312	0.2084
17-May-08	0.00000	0.00000	0.0000
18-May-08	0.00000	0.00000	0.0000
19-May-08	0.17801	0.17838	0.2084
20-May-08	0.00000	0.00000	0.0000
21-May-08	0.00000	0.00000	0.0000
22-May-08	0.00000	0.00000	0.0000
23-May-08	0.00000	0.00000	0.0000
24-May-08	0.00000	0.00000	0.0000
25-May-08	0.01300	0.01303	0.2084
26-May-08	0.01599	0.01602	0.2084

27-May-08	0.12500	0.12526	0.2084
28-May-08	0.00000	0.00000	0.0000
29-May-08	0.00000	0.00000	0.0000
30-May-08	0.00000	0.00000	0.0000
31-May-08	0.00000	0.00000	0.0000
01-Jun-08	0.00000	0.00000	0.0000
02-Jun-08	0.00000	0.00000	0.0000
03-Jun-08	0.00000	0.00000	0.0000
04-Jun-08	0.00000	0.00000	0.0000
05-Jun-08	0.00000	0.00000	0.0000
06-Jun-08	0.00000	0.00000	0.0000
07-Jun-08	0.00000	0.00000	0.0000
08-Jun-08	0.00000	0.00000	0.0000
09-Jun-08	0.00000	0.00000	0.0000
10-Jun-08	0.00000	0.00000	0.0000
11-Jun-08	0.00000	0.00000	0.0000
12-Jun-08	0.00000	0.00000	0.0000
13-Jun-08	0.01599	0.01602	0.2084
14-Jun-08	0.00000	0.00000	0.0000
15-Jun-08	0.00000	0.00000	0.0000
16-Jun-08	0.00000	0.00000	0.0000
17-Jun-08	0.00000	0.00000	0.0000
18-Jun-08	0.00000	0.00000	0.0000
19-Jun-08	0.00000	0.00000	0.0000
20-Jun-08	0.00702	0.00703	0.2084
21-Jun-08	0.00000	0.00000	0.0000
22-Jun-08	0.00000	0.00000	0.0000
23-Jun-08	0.00000	0.00000	0.0000
24-Jun-08	0.00000	0.00000	0.0000
25-Jun-08	0.00000	0.00000	0.0000
26-Jun-08	0.00000	0.00000	0.0000
27-Jun-08	0.00000	0.00000	0.0000
28-Jun-08	0.00000	0.00000	0.0000
29-Jun-08	0.00000	0.00000	0.0000
30-Jun-08	0.00000	0.00000	0.0000
01-Jul-08	0.00000	0.00000	0.0000
02-Jul-08	0.00000	0.00000	0.0000
03-Jul-08	0.00000	0.00000	0.0000
04-Jul-08	0.00000	0.00000	0.0000
05-Jul-08	0.00000	0.00000	0.0000
06-Jul-08	0.00000	0.00000	0.0000
07-Jul-08	0.00000	0.00000	0.0000
08-Jul-08	0.00000	0.00000	0.0000
09-Jul-08	0.00000	0.00000	0.0000
10-Jul-08	0.00000	0.00000	0.0000
11-Jul-08	0.00000	0.00000	0.0000
12-Jul-08	0.00000	0.00000	0.0000
13-Jul-08	0.00000	0.00000	0.0000

14-Jul-08	0.00998	0.01000	0.2084
15-Jul-08	0.00000	0.00000	0.0000
16-Jul-08	0.00000	0.00000	0.0000
17-Jul-08	0.00000	0.00000	0.0000
18-Jul-08	0.00000	0.00000	0.0000
19-Jul-08	0.00000	0.00000	0.0000
20-Jul-08	0.00000	0.00000	0.0000
21-Jul-08	0.00000	0.00000	0.0000
22-Jul-08	0.00000	0.00000	0.0000
23-Jul-08	0.00000	0.00000	0.0000
24-Jul-08	0.00000	0.00000	0.0000
25-Jul-08	0.00000	0.00000	0.0000
26-Jul-08	0.00000	0.00000	0.0000
27-Jul-08	0.00000	0.00000	0.0000
28-Jul-08	0.00000	0.00000	0.0000
29-Jul-08	0.00000	0.00000	0.0000
30-Jul-08	0.00000	0.00000	0.0000
31-Jul-08	0.52402	0.52511	0.2084
01-Aug-08	0.00000	0.00000	0.0000
02-Aug-08	0.00000	0.00000	0.0000
03-Aug-08	0.00000	0.00000	0.0000
04-Aug-08	0.01498	0.01501	0.2084
05-Aug-08	0.00000	0.00000	0.0000
06-Aug-08	0.00000	0.00000	0.0000
07-Aug-08	0.00000	0.00000	0.0000
08-Aug-08	0.00000	0.00000	0.0000
09-Aug-08	0.00000	0.00000	0.0000
10-Aug-08	0.00000	0.00000	0.0000
11-Aug-08	0.00000	0.00000	0.0000
12-Aug-08	0.00000	0.00000	0.0000
13-Aug-08	0.00000	0.00000	0.0000
14-Aug-08	0.00000	0.00000	0.0000
15-Aug-08	0.00000	0.00000	0.0000
16-Aug-08	0.00000	0.00000	0.0000
17-Aug-08	0.00000	0.00000	0.0000
18-Aug-08	0.00900	0.00902	0.2084
19-Aug-08	0.00000	0.00000	0.0000
20-Aug-08	0.00000	0.00000	0.0000
21-Aug-08	0.00000	0.00000	0.0000
22-Aug-08	0.00000	0.00000	0.0000
23-Aug-08	0.00000	0.00000	0.0000
24-Aug-08	0.00000	0.00000	0.0000
25-Aug-08	0.00000	0.00000	0.0000
26-Aug-08	0.05300	0.05305	0.1024