



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

A Report for

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

PROJECT NO: NGR010

REPORT NO: 2010/227

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

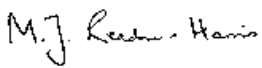
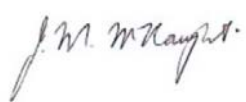
- 1** This report may be published in full by the client unless it includes information supplied in confidence by TUV NEL Ltd or any third party. Such information, if included within the report, shall be identified as confidential by TUV NEL Ltd.
- 2a** The prior written consent of TUV NEL Ltd shall 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.tuwnel.com

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

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 Blyborough a correction factor of 1.002254 should be applied during the period of mis-measurement.

Over the period 07/06/2007 to 02/07/2008 inclusive the flow was 731.09199 mscm and the corrected flow should be 732.73949 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 Blyborough in the period of the error. The Joint Office Error Code is EM005.

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	Measured values		Values at 20 °C
			Orifice Bore (mm)	Temperature (°C)	Orifice Bore (mm)
OP4145	288-3	06/05/2005	256.4890	21	256.4849
OP50129	288-2	05/05/2006	257.0885	21	257.0844
OP60131	288-3	31/10/2006	256.2410	21	256.2369
OP80025	288-2	11/06/2008	257.0870	20	257.0870
OP80046	288-3	08/08/2008	256.4945	20	256.4945
OP90026	288-2	20/07/2009	257.0970	20.3	257.0958

Figure 1 shows the data from Table 1 for the orifice bores at 20°C. This figure shows that there is a reduction in measured diameter followed by a recovery. The deduction from this graph is that a plate was mis-measured.

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

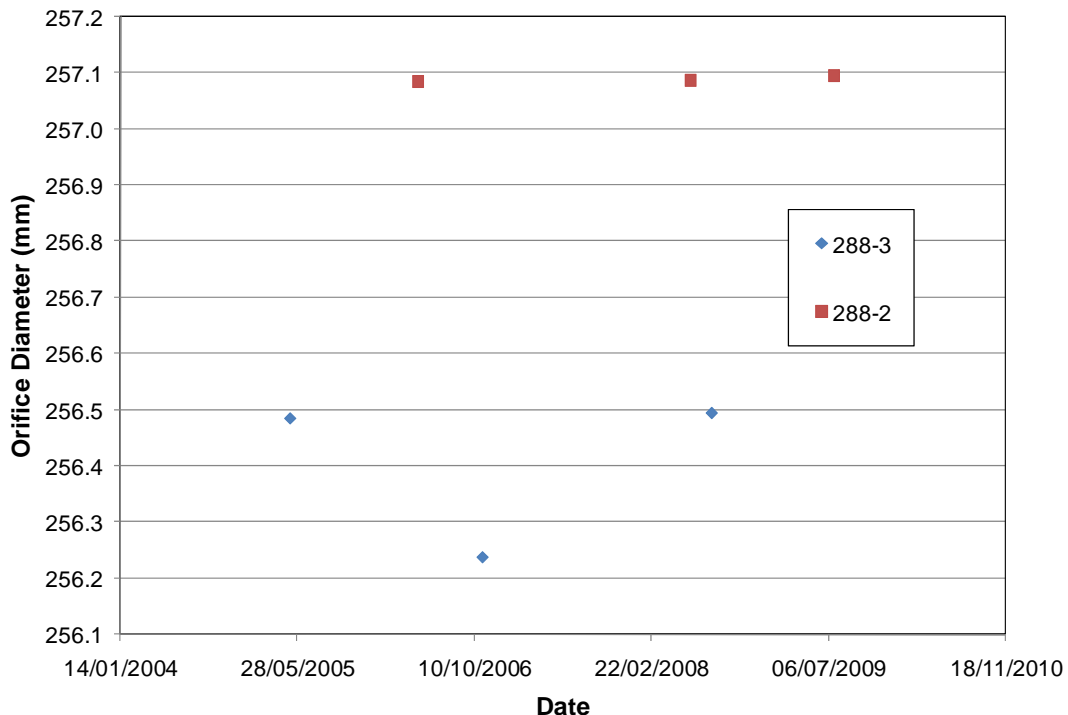


Figure 1 Orifice Diameters at 20 °C

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	omnM0604.cfg	omnM0607.cfg	omnN0702.cfg
	04/06/2007 23:01	07/06/2007 23:01	02/07/2008 23:01
Orifice plate bore diameter (mm)	257.0885	256.241	257.087
Expansion coefficient of the plate (1/°C)	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	20
Meter tube diameter (mm)	432.805	432.805	432.805
Expansion coefficient of the meter tube (1/°C)	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20
Isentropic Exponent	1.334	1.334	1.3305
Dynamic Viscosity (Pa.s)	0.000012	0.000012	0.0000117
Orifice plate certificate number	OP50129	OP60131	OP80025
Orifice plate serial number	288-2	288-3	288-2
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:

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

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 57 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00002% at maximum.

Over the period from 07/06/2007 to 02/07/2008 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 432.805 mm, the isentropic exponent is 1.334 and the dynamic viscosity 0.000012 Pa s.

TABLE 3

THE CORRECTION FROM 07/06/2007 TO 02/07/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	256.2369	0.592038	0.999940	2587165	0.604213	
Corrected $\Delta p=10$ mbar	256.4897	0.592622	0.999940	2592998	0.604215	1.0022548
Original $\Delta p=500$ mbar	256.2369	0.592038	0.997021	18231706	0.603918	
Corrected $\Delta p=500$ mbar	256.4897	0.592622	0.997020	18272787	0.603920	1.0022533

So $q_{m,c}/q_{m,o}$ is 1.002254.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 07/06/2007 to 02/07/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 08:30 therefore all of the flow for 07/06/2007 has to be corrected but none of that for 02/07/2008. Summing the data gives the figures in Table 5.

TABLE 5

THE FLOW OVER THE PERIOD 07/06/2007 TO 02/07/2008 INCLUSIVE

Flow (mscm)	731.09199
Correction (mscm)	1.64762
Corrected flow (mscm)	732.73961
% change	0.2254

5 CONCLUSIONS

A correction factor of 1.002254 should be applied during the period of mis-measurement.

**APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES
TRANSCO ORIFICE PLATE CALIBRATION**

DATE: 06-05-05
REF NO: OP4145
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 256.489mm

PLATE DETAILS

PLATE SERIAL.	288-3	PLATE O.D	507.956mm		
MANUFACTURER:		PIPE I.D:	432.7906mm	SITE	BLYBOROUGH
MATERIAL CERT.No		DESIGN BORE	256.460mm	FLOW	6750000 M ³ /day

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	2	3				
FLATNESS λ			0.045	0.032	L04	0.06
IE mm			9.486	9.488	9.497	9.491
mm	7.298	7.238	7.16	7.294	7.413	7.406
EDGE SHARPNESS mm			0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE	37 DEGS					
CONCENTRICITY	0.219mm					
SURFACE FINISH (Ra)	1.9 microns					
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS					
ROUNDNESS .026mm	TAPER	0 deas				

COMMENTS

INSPECTED BY



G. WARDLE

VERIFIED BY



P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 15-05-06
REF NO: OP50129
TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 257.0885mm

PLATE DETAILS

PLATE SERIAL.	288-2	PLATE O.D	507.894mm		
MANUFACTURER:		PIPE I.D:	432.7906mm	SITE	BLYBOROUGH
MATERIAL CERT.No		DESIGN BORE	256.460mm	FLOW	6.75X10E06 M ³ /DAY

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	4				
FLATNESS μ	0.007	0.033	0.021	0.004	0.014	0.010	0.019
\bar{E} mm	9.450	9.439	9.423	9.421	9.425	9.431	9.430
	7.296	7.292	7.302	7.299	7.304	7.276	7.289
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE	45 DEGS						
CONCENTRICITY	0.070mm						
SURFACE FINISH (Ra)	1.8 microns						
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS						
ROUNDNESS	0.012mm	TAPER	0 degs				

COMMENTS

INSPECTED BY

 P. KENNERSON  J. CHAUHAN

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 31-10-06
REF NO: OP60131
TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 256.241mm

PLATE DETAILS

PLATE SERIAL. 288-3 PLATE O.D 507.558mm
 MANUFACTURER: PIPE I.D: 432.79mm SITE: BLYBOROUGH
 MATERIAL CERT.No. DESIGN BORE: 256.460mm FLOW: 6.75X10E06 M³/DAY

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	5			
FLATNESS μ	0.160	0.118	0.025	0.039	0.108	0.105	0.063	
'E' mm	9.521	9.455	9.472	9.554	9.558	9.488	9.488	9.539
'e' mm	6.998	6.998	7.132	7.357	7.351	7.387	7.282	7.164
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.216mm							
SURFACE FINISH (Ra)	1.7 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS :	0.238mm	TAPER:	0 degs					

COMMENTS:

INSPECTED BY:  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 11-JUNE-2008

REF NO: OP80025

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 257.087mm

PLATE DETAILS

PLATE SERIAL. 288-2 PLATE O.D 507.894mm
 MANUFACTURER: PIPE I.D: 432.805mm SITE: BLYBOROUGH
 MATERIAL CERT.No. DESIGN BORE: 256.460mm FLOW: 6.75X10E06 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

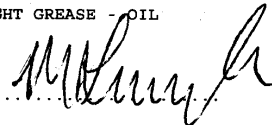
UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5			
FLATNESS %	0.013	0.040	0.032	0.002	0.004	0.019	0.005	0.003
'E' mm	9.440	9.429	9.413	9.419	9.426	9.438	9.436	9.447
'e' mm	7.250	7.265	7.274	7.285	7.268	7.268	7.270	7.275
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.025	0.025	0.0125	0.025
BEVEL ANGLE:	44 DEGS							
CONCENTRICITY	0.061mm							
SURFACE FINISH (Ra)	1.8 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.007mm TAPER: 0 degs

COMMENTS: LIGHT GREASE - OIL

INSPECTED BY:  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 08-AUG-2008
REF NO: OP80046
TEMPERATURE: 20 degsC
MEASURED ORIFICE BORE: 256.4945mm

PLATE DETAILS

PLATE SERIAL.	288-3	PLATE O.D	507.968mm	SITE:	BLYBOROUGH
MANUFACTURER:		PIPE I.D:	432.805mm	FLOW:	6.75X10E06 M ³ /DAY
MATERIAL CERT.No		DESIGN BORE:	256.460mm		

TEST EQUIPMENT

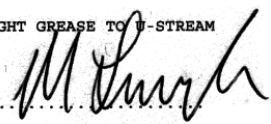
MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6292. NEXT CAL DUE:- 05-OCTOBER-2008

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS μ	0.146	0.141	0.039	0.018	0.101	0.105	0.063	0.086
ϕ mm	9.465	9.473	9.485	9.478	9.486	9.500	9.483	9.483
ϕ mm	6.981	6.987	7.144	7.300	7.401	7.397	7.319	7.149
EDGE SHARPNESS mm	0.0125	SQUARE	0.025	0.0125	0.0125	SQUARE	0.0125	0.0125
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.222mm							
SURFACE FINISH (Ra)	0.8 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.005mm	TAPER:	0 degs					

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: LIGHT GREASE TO U-STREAM

INSPECTED BY:  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 20-JULY-2009

REF NO: OP90026

TEMPERATURE: 20.3 degsC

MEASURED ORIFICE BORE: 257.097mm

PLATE DETAILS

PLATE SERIAL.	288-2	PLATE O.D.	507.896mm		
MANUFACTURER:		PIPE I.D.:	432.805mm	SITE:	BLYBOROUGH
MATERIAL CERT.No.		DESIGN BORE:	256.46mm	FLOW:	6.75X10E06 M ³ /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:-	1	2	3	4	5	6	7	8
FLATNESS %	0.018	0.031	0.034	0.008	0.002	0.026	0.019	0.005
mm	9.447	9.435	9.419	9.419	9.419	9.438	9.435	9.450
mm	7.272	7.278	7.290	7.275	7.308	7.280	7.290	7.283
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.025	0.0125	0.025	0.025	0.025
BEVEL ANGLE:	45 DEGS							
CONCENTRICITY	0.063mm							
SURFACE FINISH (Ra)	1.8 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.006mm 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 BLYBOROUGH DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
07-Jun-07	0.1030	0.10326	0.2254
08-Jun-07	0.0639	0.06408	0.2254
09-Jun-07	0.0000	0.00000	0.0000
10-Jun-07	0.0000	0.00000	0.0000
11-Jun-07	0.0000	0.00000	0.0000
12-Jun-07	0.1100	0.11023	0.2254
13-Jun-07	0.0000	0.00000	0.0000
14-Jun-07	0.0000	0.00000	0.0000
15-Jun-07	0.0000	0.00000	0.0000
16-Jun-07	0.0000	0.00000	0.0000
17-Jun-07	0.0000	0.00000	0.0000
18-Jun-07	0.0000	0.00000	0.0000
19-Jun-07	0.0000	0.00000	0.0000
20-Jun-07	0.0000	0.00000	0.0000
21-Jun-07	0.0000	0.00000	0.0000
22-Jun-07	0.0000	0.00000	0.0000
23-Jun-07	0.5520	0.55324	0.2254
24-Jun-07	0.0000	0.00000	0.0000
25-Jun-07	2.1720	2.17690	0.2254
26-Jun-07	2.2860	2.29115	0.2254
27-Jun-07	0.8240	0.82586	0.2254
28-Jun-07	0.0000	0.00000	0.0000
29-Jun-07	0.0000	0.00000	0.0000
30-Jun-07	0.0000	0.00000	0.0000
01-Jul-07	0.0000	0.00000	0.0000
02-Jul-07	0.0000	0.00000	0.0000
03-Jul-07	0.0000	0.00000	0.0000
04-Jul-07	0.0000	0.00000	0.0000
05-Jul-07	0.0000	0.00000	0.0000
06-Jul-07	0.0000	0.00000	0.0000
07-Jul-07	0.0000	0.00000	0.0000
08-Jul-07	0.0000	0.00000	0.0000
09-Jul-07	0.0000	0.00000	0.0000
10-Jul-07	0.0000	0.00000	0.0000
11-Jul-07	0.0000	0.00000	0.0000
12-Jul-07	0.0000	0.00000	0.0000
13-Jul-07	0.0000	0.00000	0.0000
14-Jul-07	0.0000	0.00000	0.0000
15-Jul-07	0.0000	0.00000	0.0000

16-Jul-07	0.0000	0.00000	0.0000
17-Jul-07	0.0000	0.00000	0.0000
18-Jul-07	0.0000	0.00000	0.0000
19-Jul-07	0.0000	0.00000	0.0000
20-Jul-07	0.0000	0.00000	0.0000
21-Jul-07	0.0000	0.00000	0.0000
22-Jul-07	0.0000	0.00000	0.0000
23-Jul-07	0.0000	0.00000	0.0000
24-Jul-07	0.0000	0.00000	0.0000
25-Jul-07	0.0000	0.00000	0.0000
26-Jul-07	0.0000	0.00000	0.0000
27-Jul-07	0.0000	0.00000	0.0000
28-Jul-07	0.0000	0.00000	0.0000
29-Jul-07	0.0000	0.00000	0.0000
30-Jul-07	0.0000	0.00000	0.0000
31-Jul-07	0.0000	0.00000	0.0000
01-Aug-07	0.0000	0.00000	0.0000
02-Aug-07	0.0000	0.00000	0.0000
03-Aug-07	0.0000	0.00000	0.0000
04-Aug-07	0.0000	0.00000	0.0000
05-Aug-07	0.0000	0.00000	0.0000
06-Aug-07	0.0000	0.00000	0.0000
07-Aug-07	0.0000	0.00000	0.0000
08-Aug-07	0.0000	0.00000	0.0000
09-Aug-07	0.0000	0.00000	0.0000
10-Aug-07	0.0000	0.00000	0.0000
11-Aug-07	0.0000	0.00000	0.0000
12-Aug-07	0.0000	0.00000	0.0000
13-Aug-07	0.0000	0.00000	0.0000
14-Aug-07	0.0000	0.00000	0.0000
15-Aug-07	0.0000	0.00000	0.0000
16-Aug-07	0.0000	0.00000	0.0000
17-Aug-07	0.0000	0.00000	0.0000
18-Aug-07	0.0000	0.00000	0.0000
19-Aug-07	0.0000	0.00000	0.0000
20-Aug-07	0.0000	0.00000	0.0000
21-Aug-07	0.0000	0.00000	0.0000
22-Aug-07	0.0000	0.00000	0.0000
23-Aug-07	0.0000	0.00000	0.0000
24-Aug-07	0.0000	0.00000	0.0000
25-Aug-07	0.0000	0.00000	0.0000
26-Aug-07	0.0000	0.00000	0.0000
27-Aug-07	0.0000	0.00000	0.0000
28-Aug-07	0.0000	0.00000	0.0000
29-Aug-07	0.0040	0.00401	0.2254
30-Aug-07	0.0000	0.00000	0.0000
31-Aug-07	0.0000	0.00000	0.0000
01-Sep-07	0.0000	0.00000	0.0000

02-Sep-07	0.0000	0.00000	0.0000
03-Sep-07	0.0000	0.00000	0.0000
04-Sep-07	0.0000	0.00000	0.0000
05-Sep-07	0.0000	0.00000	0.0000
06-Sep-07	0.0000	0.00000	0.0000
07-Sep-07	0.0000	0.00000	0.0000
08-Sep-07	0.0000	0.00000	0.0000
09-Sep-07	0.0000	0.00000	0.0000
10-Sep-07	0.0000	0.00000	0.0000
11-Sep-07	0.0120	0.01203	0.2254
12-Sep-07	0.0000	0.00000	0.0000
13-Sep-07	0.0000	0.00000	0.0000
14-Sep-07	0.0000	0.00000	0.0000
15-Sep-07	0.0000	0.00000	0.0000
16-Sep-07	0.0000	0.00000	0.0000
17-Sep-07	0.0000	0.00000	0.0000
18-Sep-07	0.0000	0.00000	0.0000
19-Sep-07	0.0000	0.00000	0.0000
20-Sep-07	0.0000	0.00000	0.0000
21-Sep-07	0.0000	0.00000	0.0000
22-Sep-07	0.0000	0.00000	0.0000
23-Sep-07	0.0000	0.00000	0.0000
24-Sep-07	0.0000	0.00000	0.0000
25-Sep-07	0.0000	0.00000	0.0000
26-Sep-07	0.0000	0.00000	0.0000
27-Sep-07	0.0000	0.00000	0.0000
28-Sep-07	0.0000	0.00000	0.0000
29-Sep-07	0.0000	0.00000	0.0000
30-Sep-07	0.0000	0.00000	0.0000
01-Oct-07	0.0000	0.00000	0.0000
02-Oct-07	0.5050	0.50614	0.2254
03-Oct-07	0.0000	0.00000	0.0000
04-Oct-07	0.2570	0.25758	0.2254
05-Oct-07	0.0000	0.00000	0.0000
06-Oct-07	0.0000	0.00000	0.0000
07-Oct-07	0.0000	0.00000	0.0000
08-Oct-07	0.0000	0.00000	0.0000
09-Oct-07	0.0000	0.00000	0.0000
10-Oct-07	0.0000	0.00000	0.0000
11-Oct-07	0.0000	0.00000	0.0000
12-Oct-07	0.0000	0.00000	0.0000
13-Oct-07	0.0000	0.00000	0.0000
14-Oct-07	0.0000	0.00000	0.0000
15-Oct-07	0.0000	0.00000	0.0000
16-Oct-07	0.0000	0.00000	0.0000
17-Oct-07	0.0000	0.00000	0.0000
18-Oct-07	0.0000	0.00000	0.0000
19-Oct-07	0.0000	0.00000	0.0000

20-Oct-07	0.0000	0.00000	0.0000
21-Oct-07	0.0000	0.00000	0.0000
22-Oct-07	0.0000	0.00000	0.0000
23-Oct-07	0.0000	0.00000	0.0000
24-Oct-07	2.2760	2.28113	0.2254
25-Oct-07	2.3010	2.30619	0.2254
26-Oct-07	2.1880	2.19293	0.2254
27-Oct-07	0.0200	0.02005	0.2254
28-Oct-07	0.0000	0.00000	0.0000
29-Oct-07	0.0000	0.00000	0.0000
30-Oct-07	0.0000	0.00000	0.0000
31-Oct-07	0.0000	0.00000	0.0000
01-Nov-07	0.0000	0.00000	0.0000
02-Nov-07	0.0000	0.00000	0.0000
03-Nov-07	0.0000	0.00000	0.0000
04-Nov-07	0.0000	0.00000	0.0000
05-Nov-07	0.0000	0.00000	0.0000
06-Nov-07	0.0000	0.00000	0.0000
07-Nov-07	1.9890	1.99348	0.2254
08-Nov-07	2.2970	2.30218	0.2254
09-Nov-07	2.6620	2.66800	0.2254
10-Nov-07	2.6610	2.66700	0.2254
11-Nov-07	3.7170	3.72538	0.2254
12-Nov-07	4.8330	4.84389	0.2254
13-Nov-07	4.7740	4.78476	0.2254
14-Nov-07	4.8220	4.83287	0.2254
15-Nov-07	5.3850	5.39714	0.2254
16-Nov-07	5.2800	5.29190	0.2254
17-Nov-07	4.9340	4.94512	0.2254
18-Nov-07	5.1050	5.11651	0.2254
19-Nov-07	5.0700	5.08143	0.2254
20-Nov-07	4.1370	4.14632	0.2254
21-Nov-07	3.1520	3.15910	0.2254
22-Nov-07	3.1360	3.14307	0.2254
23-Nov-07	4.2070	4.21648	0.2254
24-Nov-07	5.1180	5.12954	0.2254
25-Nov-07	4.5940	4.60434	0.2254
26-Nov-07	4.7020	4.71260	0.2254
27-Nov-07	4.6730	4.68353	0.2254
28-Nov-07	4.5340	4.54422	0.2254
29-Nov-07	4.8390	4.84991	0.2254
30-Nov-07	3.5420	3.54998	0.2254
01-Dec-07	1.3260	1.32899	0.2254
02-Dec-07	1.3480	1.35104	0.2254
03-Dec-07	3.8540	3.86269	0.2254
04-Dec-07	4.0260	4.03507	0.2254
05-Dec-07	4.1850	4.19444	0.2254
06-Dec-07	4.1060	4.11525	0.2254

07-Dec-07	3.1910	3.19820	0.2254
08-Dec-07	4.5210	4.53119	0.2254
09-Dec-07	4.1120	4.12127	0.2254
10-Dec-07	4.7540	4.76472	0.2254
11-Dec-07	5.2960	5.30795	0.2254
12-Dec-07	5.1690	5.18064	0.2254
13-Dec-07	5.5300	5.54246	0.2254
14-Dec-07	5.7130	5.72589	0.2254
15-Dec-07	5.4810	5.49334	0.2254
16-Dec-07	6.2300	6.24405	0.2254
17-Dec-07	5.7210	5.73389	0.2254
18-Dec-07	5.5440	5.55651	0.2254
19-Dec-07	4.6960	4.70658	0.2254
20-Dec-07	6.0130	6.02655	0.2254
21-Dec-07	5.2480	5.25983	0.2254
22-Dec-07	5.0970	5.10849	0.2254
23-Dec-07	5.1890	5.20070	0.2254
24-Dec-07	4.9390	4.95013	0.2254
25-Dec-07	4.1490	4.15835	0.2254
26-Dec-07	4.5060	4.51617	0.2254
27-Dec-07	3.9100	3.91880	0.2254
28-Dec-07	3.6380	3.64620	0.2254
29-Dec-07	4.2890	4.29867	0.2254
30-Dec-07	3.2460	3.25332	0.2254
31-Dec-07	2.9930	2.99975	0.2254
01-Jan-08	3.5220	3.52994	0.2254
02-Jan-08	4.5530	4.56327	0.2254
03-Jan-08	5.2020	5.21373	0.2254
04-Jan-08	3.9520	3.96091	0.2254
05-Jan-08	4.5930	4.60337	0.2254
06-Jan-08	5.0740	5.08541	0.2254
07-Jan-08	5.2100	5.22176	0.2254
08-Jan-08	5.1860	5.19766	0.2254
09-Jan-08	5.0000	5.01130	0.2254
10-Jan-08	4.9100	4.92104	0.2254
11-Jan-08	5.7580	5.77101	0.2254
12-Jan-08	4.7700	4.78074	0.2254
13-Jan-08	3.9850	3.99397	0.2254
14-Jan-08	4.2920	4.30169	0.2254
15-Jan-08	4.8030	4.81381	0.2254
16-Jan-08	5.0320	5.04335	0.2254
17-Jan-08	4.9720	4.98319	0.2254
18-Jan-08	4.0100	4.01905	0.2254
19-Jan-08	3.6470	3.65522	0.2254
20-Jan-08	3.4800	3.48785	0.2254
21-Jan-08	4.0110	4.02003	0.2254
22-Jan-08	4.6300	4.64044	0.2254
23-Jan-08	4.2300	4.23954	0.2254

24-Jan-08	4.4360	4.44597	0.2254
25-Jan-08	4.4130	4.42297	0.2254
26-Jan-08	3.7650	3.77347	0.2254
27-Jan-08	3.7370	3.74542	0.2254
28-Jan-08	4.0670	4.07619	0.2254
29-Jan-08	5.5140	5.52641	0.2254
30-Jan-08	5.3490	5.36106	0.2254
31-Jan-08	5.1650	5.17665	0.2254
01-Feb-08	5.3120	5.32398	0.2254
02-Feb-08	5.2910	5.30292	0.2254
03-Feb-08	4.9920	5.00325	0.2254
04-Feb-08	4.8540	4.86494	0.2254
05-Feb-08	4.7250	4.73566	0.2254
06-Feb-08	5.3480	5.36004	0.2254
07-Feb-08	4.3510	4.36082	0.2254
08-Feb-08	3.6800	3.68828	0.2254
09-Feb-08	3.4500	3.45779	0.2254
10-Feb-08	3.3570	3.36456	0.2254
11-Feb-08	4.5320	4.54220	0.2254
12-Feb-08	4.5500	4.56028	0.2254
13-Feb-08	4.3860	4.39588	0.2254
14-Feb-08	4.6530	4.66351	0.2254
15-Feb-08	4.6990	4.70960	0.2254
16-Feb-08	4.7100	4.72061	0.2254
17-Feb-08	4.8830	4.89401	0.2254
18-Feb-08	5.6100	5.62266	0.2254
19-Feb-08	5.5080	5.52042	0.2254
20-Feb-08	4.7190	4.72963	0.2254
21-Feb-08	4.6820	4.69256	0.2254
22-Feb-08	3.8790	3.88774	0.2254
23-Feb-08	3.8310	3.83963	0.2254
24-Feb-08	3.9000	3.90878	0.2254
25-Feb-08	4.1550	4.16437	0.2254
26-Feb-08	4.3520	4.36183	0.2254
27-Feb-08	4.2100	4.21948	0.2254
28-Feb-08	4.1480	4.15736	0.2254
29-Feb-08	4.6590	4.66950	0.2254
01-Mar-08	4.7270	4.73764	0.2254
02-Mar-08	4.1340	4.14329	0.2254
03-Mar-08	4.6530	4.66351	0.2254
04-Mar-08	4.8020	4.81282	0.2254
05-Mar-08	4.5300	4.54024	0.2254
06-Mar-08	3.8180	3.82660	0.2254
07-Mar-08	3.5720	3.58001	0.2254
08-Mar-08	3.7401	3.74848	0.2254
09-Mar-08	3.5460	3.55395	0.2254
10-Mar-08	4.4950	4.50513	0.2254
11-Mar-08	3.1060	3.11302	0.2254

12-Mar-08	3.7820	3.79050	0.2254
13-Mar-08	3.7190	3.72737	0.2254
14-Mar-08	3.2760	3.28338	0.2254
15-Mar-08	3.8110	3.81963	0.2254
16-Mar-08	4.5220	4.53216	0.2254
17-Mar-08	3.2390	3.24630	0.2254
18-Mar-08	5.1480	5.15960	0.2254
19-Mar-08	4.5360	4.54622	0.2254
20-Mar-08	4.7200	4.73064	0.2254
21-Mar-08	4.1470	4.15635	0.2254
22-Mar-08	4.2570	4.26660	0.2254
23-Mar-08	4.1240	4.13330	0.2254
24-Mar-08	3.7520	3.76046	0.2254
25-Mar-08	4.4820	4.49210	0.2254
26-Mar-08	4.6310	4.64144	0.2254
27-Mar-08	4.2380	4.24755	0.2254
28-Mar-08	3.4490	3.45677	0.2254
29-Mar-08	3.7180	3.72638	0.2254
30-Mar-08	2.9630	2.96968	0.2254
31-Mar-08	2.5210	2.52668	0.2254
01-Apr-08	3.4780	3.48584	0.2254
02-Apr-08	3.2470	3.25432	0.2254
03-Apr-08	2.4060	2.41143	0.2254
04-Apr-08	2.1580	2.16286	0.2254
05-Apr-08	3.3090	3.31646	0.2254
06-Apr-08	4.4320	4.44199	0.2254
07-Apr-08	4.3410	4.35078	0.2254
08-Apr-08	4.6080	4.61839	0.2254
09-Apr-08	4.3720	4.38185	0.2254
10-Apr-08	4.1460	4.15535	0.2254
11-Apr-08	3.5190	3.52693	0.2254
12-Apr-08	2.5540	2.55975	0.2254
13-Apr-08	2.8100	2.81634	0.2254
14-Apr-08	4.5290	4.53921	0.2254
15-Apr-08	4.5630	4.57329	0.2254
16-Apr-08	4.2580	4.26760	0.2254
17-Apr-08	4.8550	4.86594	0.2254
18-Apr-08	4.5680	4.57830	0.2254
19-Apr-08	3.4390	3.44675	0.2254
20-Apr-08	3.0530	3.05987	0.2254
21-Apr-08	2.6810	2.68704	0.2254
22-Apr-08	0.0000	0.00000	0.0000
23-Apr-08	0.0000	0.00000	0.0000
24-Apr-08	2.7860	2.79228	0.2254
25-Apr-08	0.2190	0.21950	0.2254
26-Apr-08	0.0000	0.00000	0.0000
27-Apr-08	0.0000	0.00000	0.0000
28-Apr-08	0.0000	0.00000	0.0000

29-Apr-08	0.0000	0.00000	0.0000
30-Apr-08	0.0000	0.00000	0.0000
01-May-08	0.0010	0.00099	0.2254
02-May-08	0.0000	0.00000	0.0000
03-May-08	0.0000	0.00000	0.0000
04-May-08	0.0000	0.00000	0.0000
05-May-08	0.0000	0.00000	0.0000
06-May-08	0.0000	0.00000	0.0000
07-May-08	0.0000	0.00000	0.0000
08-May-08	0.0000	0.00000	0.0000
09-May-08	0.0000	0.00000	0.0000
10-May-08	0.0000	0.00000	0.0000
11-May-08	0.0000	0.00000	0.0000
12-May-08	0.0000	0.00000	0.0000
13-May-08	0.0000	0.00000	0.0000
14-May-08	0.0000	0.00000	0.0000
15-May-08	0.0000	0.00000	0.0000
16-May-08	0.0990	0.09922	0.2254
17-May-08	0.0000	0.00000	0.0000
18-May-08	0.0000	0.00000	0.0000
19-May-08	0.0000	0.00000	0.0000
20-May-08	0.0000	0.00000	0.0000
21-May-08	0.0360	0.03609	0.2254
22-May-08	0.0000	0.00000	0.0000
23-May-08	0.0000	0.00000	0.0000
24-May-08	0.0000	0.00000	0.0000
25-May-08	0.0000	0.00000	0.0000
26-May-08	0.0000	0.00000	0.0000
27-May-08	0.0000	0.00000	0.0000
28-May-08	0.1830	0.18341	0.2254
29-May-08	0.0000	0.00000	0.0000
30-May-08	0.0000	0.00000	0.0000
31-May-08	0.0000	0.00000	0.0000
01-Jun-08	0.0000	0.00000	0.0000
02-Jun-08	0.0000	0.00000	0.0000
03-Jun-08	0.0000	0.00000	0.0000
04-Jun-08	0.0000	0.00000	0.0000
05-Jun-08	0.1440	0.14432	0.2254
06-Jun-08	0.0000	0.00000	0.0000
07-Jun-08	0.0000	0.00000	0.0000
08-Jun-08	0.0000	0.00000	0.0000
09-Jun-08	0.2380	0.23853	0.2254
10-Jun-08	0.0000	0.00000	0.0000
11-Jun-08	0.6020	0.60337	0.2254
12-Jun-08	0.3820	0.38287	0.2254
13-Jun-08	0.0000	0.00000	0.0000
14-Jun-08	0.0000	0.00000	0.0000
15-Jun-08	0.0000	0.00000	0.0000

16-Jun-08	0.0000	0.00000	0.0000
17-Jun-08	0.0000	0.00000	0.0000
18-Jun-08	0.0000	0.00000	0.0000
19-Jun-08	0.0000	0.00000	0.0000
20-Jun-08	0.1280	0.12830	0.2254
21-Jun-08	0.1230	0.12328	0.2254
22-Jun-08	0.0000	0.00000	0.0000
23-Jun-08	0.0000	0.00000	0.0000
24-Jun-08	0.0000	0.00000	0.0000
25-Jun-08	0.0000	0.00000	0.0000
26-Jun-08	0.0000	0.00000	0.0000
27-Jun-08	0.0000	0.00000	0.0000
28-Jun-08	0.0000	0.00000	0.0000
29-Jun-08	0.0000	0.00000	0.0000
30-Jun-08	0.0000	0.00000	0.0000
01-Jul-08	0.0000	0.00000	0.0000
02-Jul-08	0.1160	0.11600	0.0000