



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

A Report for

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

PROJECT NO: NGR010

REPORT NO: 2010/226

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

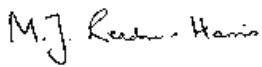
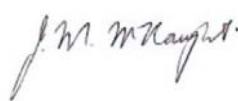
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Assessment of Error Due to Orifice Diameter Mis-Measurement at Blaby

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 Blaby a correction factor of 1.002407 should be applied during the period of mis-measurement.

Over the period 16/11/2007 to 15/12/2008 inclusive the flow was 224.42333 mscm and the corrected flow should be 224.96185 mscm.

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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 Blaby in the period of the error. The Joint Office Error Code is EM002.

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

					Values at 20°C
Calibration Reference	Plate Serial no	Declared Certificate date	Orifice Bore (mm)	Temperature (°C)	Orifice Bore (mm)
OP4013	BLAB4104	04/01/2005	127.8710	21	127.8690
OP5001	BLABY1439-1-1	26/10/2005	127.4625	21	127.4605
OP50251	BLAB4104	30/01/2007	127.8680	21	127.8660
OP70025	BLABY1439-1-1	21/02/2007	127.3390	21	127.3370
OP80001	BLAB4104	03/03/2008	127.8730	20	127.8730
OP90002	BLABY1439-1-1	16/01/2009	127.4735	20.2	127.4731
OP90050	BLAB4104	20/11/2009	127.8690	20.5	127.8680

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.

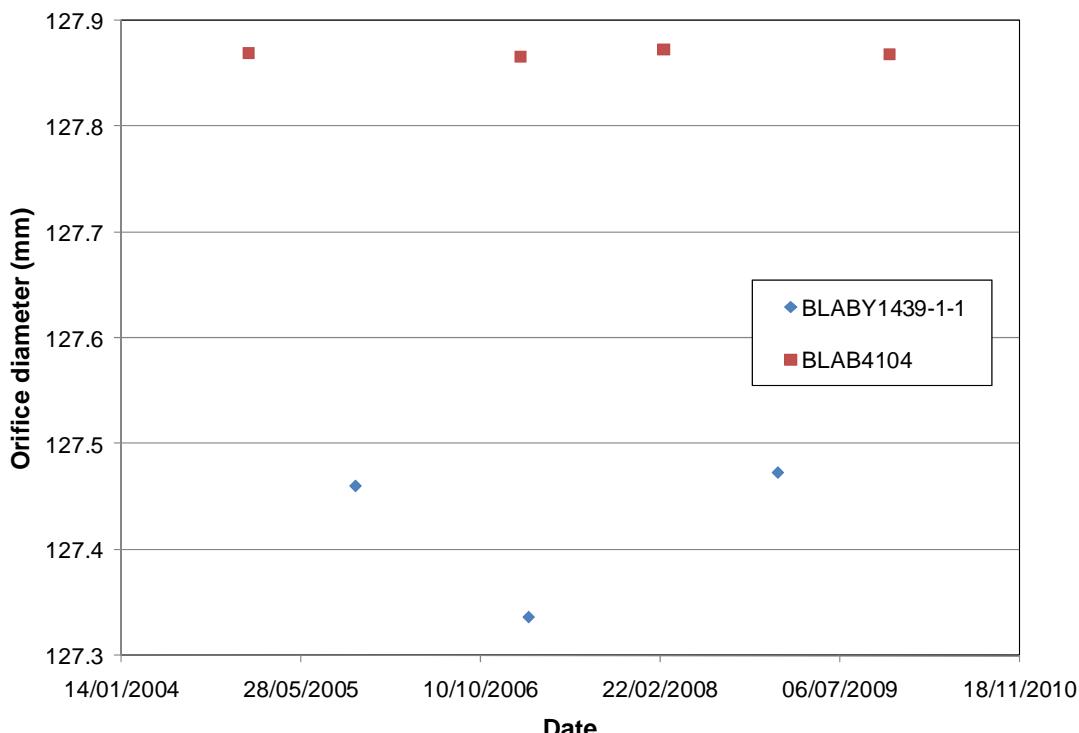


Figure 1 Orifice Diameters at 20 °C

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	omnM0202.cfg	omnM1116.cfg	omnN1210.cfg	omnN1215.cfg
	03/02/2007 00:01	17/11/2007 00:01	11/12/2008 00:01	16/12/2008 00:01
Orifice plate bore diameter (mm)	127.868	127.339	127.339	127.873
Expansion coefficient of the plate (mm/deg C)	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	21	20
Meter tube diameter (mm)	203.0899	203.0899	203.0899	203.0899
Expansion coefficient of the meter tube (mm/deg C)	0.000011	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20	20
ISENTROPIC Exponent	1.3451	1.3451	1.3443	1.3443
Dynamic Viscosity (pa.s)	0.000012	0.000012	0.000012	0.000012
Orifice plate certificate number	OP50251	OP70025	OP70025	OP80001
Orifice plate serial number	BLAB4104	BLABY1439-1-1	BLABY1439-1-1	BLAB4104
Error in orifice diameter?	No	Yes	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 0.00003% at maximum.

Over the period from 16/11/2007 to 10/12/2008 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 203.0899 mm, the isentropic exponent is 1.3451 and the dynamic viscosity 0.000012 Pa s.

TABLE 3
THE CORRECTION FROM 16/11/2007 TO 10/12/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	127.3370	0.626998	0.999939	1405274	0.604929	
Corrected $\Delta p=10$ mbar	127.4668	0.627637	0.999939	1408658	0.604926	1.0024082
Original $\Delta p=500$ mbar	127.3370	0.626998	0.996973	9898500	0.604392	
Corrected $\Delta p=500$ mbar	127.4668	0.627637	0.996972	9922317	0.604388	1.0024061

So $q_{m,c}/q_{m,o}$ is 1.002407.

Over the period from 10/12/2008 to 15/12/2008 the correction can be calculated as in Table 4; throughout this calculation the meter tube diameter is 203.0899 mm, the isentropic exponent is 1.3443 and the dynamic viscosity 0.000012 Pa s.

TABLE 4
THE CORRECTION FROM 10/12/2008 TO 15/12/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	127.3370	0.626998	0.999939	1405274	0.604929	
Corrected $\Delta p=10$ mbar	127.4668	0.627637	0.999939	1408658	0.604926	1.0024082
Original $\Delta p=500$ mbar	127.3370	0.626998	0.996972	9898482	0.604392	
Corrected $\Delta p=500$ mbar	127.4668	0.627637	0.996970	9922299	0.604388	1.0024061

So $q_{m,c}/q_{m,o}$ is 1.002407.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 16/11/2007 to 15/12/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 10:00 therefore 78.4% of the flow for 16/11/2007 has to be corrected and 21.5% of the flow has to be corrected for 15/12/2008 based on the flow before and after 10:00. Summing the data gives the figures in Table 5.

TABLE 5

THE FLOW OVER THE PERIOD 17/11/2007 TO 16/12/2008 INCLUSIVE

Flow (mscm)	224.42333
Correction (mscm)	0.53852
Corrected flow (mscm)	224.96185
% change	0.2400

5 CONCLUSIONS

A correction factor of 1.002407 should be applied during the period of mis-measurement.

**APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES**

TRANSCO ORIFICE PLATE CALIBRATION

DATE: 04-01-05
REF NO.: OP4013
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 127.871mm

PLATE DETAILS

PLATE SERIAL.	BLAB4104	PLATE O.D.	214.135mm	SITE:	BLABY
MANUFACTURER:		PIPE I.D.:	202.920mm	FLOW:	
MATERIAL CERT. NO.	M8863	DESIGN BORE:	127.867mm		1.7x10e6 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:-	1	2	3	4	5	6	7
FLATNESS ‰	0.030	0.106	0.177	0.364		0.185	0.122
E' mm	3.012	2.966	2.988	2.997	3.013	2.950	2.963
E'' mm							
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	DEGS						
CONCENTRICITY	0.084mm						
SURFACE FINISH (Ra)	1.2 microns						

DOWNTSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.019mm TAPER: 0 degs

COMMENTS:

INSPECTED BY

G. WARDLE

VERIFIED BY

P. KENNISON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 26-10-05
REF NO: OP5001
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 127.4625mm

PLATE DETAILS

PLATE SERIAL.	BLABY1439-1-1	PLATE O.D.	214.264mm
MANUFACTURER:	DANIEL	PIPE I.D.	202.9206mm
MATERIAL CERT.No.		DESIGN BORE:	127.456mm
			FLOW: 1700000 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	3	4	5	6	7	8
FLATNESS *	0.095	0.076	0.151	0.091	0.097	0.063	0.112	0.086
'E' mm	3.170	3.174	3.153	3.161	3.157	3.155	3.175	3.164
'e'								
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:								
CONCENTRICITY	0.112mm							
SURFACE FINISH (Ra)	0.6 microns							
DOWNTSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS	0.016mm	TAPER:	0 degs					

COMMENTS:

INSPECTED BY:

P. Kennerson

P. KENNERTON

NATIONAL GRID ORIFICE PLATE CALIBRATION**DATE:** 30-01-07**REF NO:** OP50251**TEMPERATURE:** 21 degsC**MEASURED ORIFICE BORE:** 127.868mm**PLATE DETAILS**

PLATE SERIAL.	BLAB4104	PLATE O.D	214.158mm
MANUFACTURER:		PIPE I.D:	202.9206mm
MATERIAL CERT.NO.	M8863	DESIGN BORE	127.456mm
		FLOW:	1.7X10E06 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:- 13/10/07

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7
FLATNESS \pm	0.057	0.127	0.191	0.185	0.083	0.148	0.122
'E' mm	3.014	2.961	2.980	2.851	3.016	3.055	2.969
'F' mm							
EDGE SHARPNESS mm	0.0125	0.025	0.025	0.025	0.025	0.0375	0.025
BEVEL ANGLE:	DEGS						
CONCENTRICITY	0.071mm						
SURFACE FINISH (Ra)							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS							
ROUNDNESS	0.008mm	TAPER:	0 degs				

COMMENTS:

INSPECTED BY:

P. KENNISON

NATIONAL GRID ORIFICE PLATE CALIBRATION**DATE:** 21-02-07**REF NO:** OP70025**TEMPERATURE:** 21 degsC**MEASURED ORIFICE BORE:** 127.339mm**PLATE DETAILS**

PLATE SERIAL.	BLABY1439-1-1	PLATE O.D.	214.094mm	SITE:	BLABY
MANUFACTURER:	DANIEL	PIPE I.D.	202.920mm	FLOW:	1.7X10E06 M ³ /DAY
MATERIAL CERT.No.	E040052	DESIGN BORE	127.456mm		

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	6	7	8
FLATNESS % mm	0.086	0.102	0.127	0.078	0.108	0.067	0.084	0.068
	3.209	3.214	3.146	3.153	3.222	3.215	3.146	3.134
EDGE SHARPNESS mm	0.0125	0.0125	SQUARE	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.132mm							
SURFACE FINISH (Ra)	0.8 microns							
DOWNTSTREAM FACE/EDGE VISUAL INSPECTION	PASS							
ROUNDNESS	0.105mm	TAPER:	0 degs					

COMMENTS

INSPECTED BY:

P. KENNERTON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 03-MAR-2008**REF NO:** OP80001**TEMPERATURE:** 20 degsC**MEASURED ORIFICE BORE:** 127.873mmPLATE DETAILS

PLATE SERIAL.	BLAB 4104	PLATE O.D	214.151mm
MANUFACTURER:		PIPE I.D:	203.0899mm
MATERIAL CERT.NO	M8863	DESIGN BORE:	127.456mm
		FLOW:	1.7X10E06 M ³ /DAY

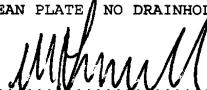
TEST EQUIPMENT

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	7	8
FLATNESS %	0.006	0.019	0.159	0.030	0.089	0.196	0.133
mm	3.007	2.956	2.986	2.922	3.013	3.047	2.964
e mm							
EDGE SHARPNESS mm	0.025	0.025	0.025	0.025	0.025	0.0375	0.025
BEVEL ANGLE DEGS							
CONCENTRICITY	0.077mm						
SURFACE FINISH (Ra)	0.9 microns						
DOWNTSTREAM FACE/EDGE VISUAL INSPECTION	PASS						
ROUNDNESS	0.012mm	TAPER:	0 degs				

COMMENTS: CLEAN PLATE NO DRAINHOLE

INSPECTED BY  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION**DATE:** 16-JAN-2009**REF NO:** OP90002**TEMPERATURE:** 20.2 degsC**MEASURED ORIFICE BORE:** 127.4735mm**PLATE DETAILS**

PLATE SERIAL.	BLABY1439-1-1	PLATE O.D	214.247mm
MANUFACTURER:	DANIEL	PIPE I.D:	203.0899mm
MATERIAL CERT.No.	E040052	DESIGN BORE:	127.456mm
		SITE:	BLABY
		FLOW:	1.7X10E06 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	6	8		
FLATNESS %	0.075	0.084	0.162	0.115	0.079	0.046	0.099	0.089
'e'	3.148	3.152	3.167	3.175	3.169	3.167	3.176	3.160
mm								
EDGE SHARPNESS mm	0.025	0.025	0.025	0.0125	0.025	0.025	0.025	0.025
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.113mm							
SURFACE FINISH (Ra)	0.7 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.014mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO) : No

COMMENTS: CLEAN PLATE

INSPECTED BY  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION**DATE:** 20-NOV-2009**REF NO:** OP90050**TEMPERATURE:** 20.5 degsC**MEASURED ORIFICE BORE:** 127.869mm**PLATE DETAILS**

PLATE SERIAL.	BLAB 4104	PLATE O.D.	214.144mm
MANUFACTURER:		PIPE I.D:	203.0899mm
MATERIAL CERT.NO.	M8863	DESIGN BORE	127.456mm
		SITE	BLABY
		FLOW	1.7 X 10E06 M^3/DAY

TEST EQUIPMENT

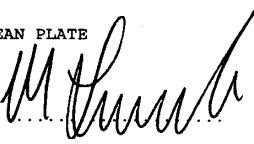
MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS TRACEABLE CERT:- 7325. NEXT CAL DUE:- 02-OCTOBER-2010

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS	1	2	3	4	5	6	7	8
FLATNESS %	0.028	0.060	0.101	0.067	0.035	0.093	0.115	0.100
'E' mm	3.000	2.957	2.994	2.844	3.007	3.047	2.954	2.990
'e' mm								
EDGE SHARPNESS mm	0.0125	0.025	0.025	0.025	0.0125	0.0375	0.025	0.025
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.083mm							
SURFACE FINISH (Ra)	0.8 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.010mm	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 BLABY DURING THE PERIOD OF THE MIS-MEASUREMENT**

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
16-Nov-07	0.7499	0.75132	0.1888
17-Nov-07	0.6862	0.68785	0.2407
18-Nov-07	0.7407	0.74248	0.2407
19-Nov-07	0.7610	0.76283	0.2407
20-Nov-07	0.7095	0.71121	0.2407
21-Nov-07	0.6688	0.67041	0.2407
22-Nov-07	0.6971	0.69878	0.2407
23-Nov-07	0.7591	0.76093	0.2407
24-Nov-07	0.7999	0.80183	0.2407
25-Nov-07	0.7045	0.70620	0.2407
26-Nov-07	0.7032	0.70489	0.2407
27-Nov-07	0.6559	0.65748	0.2407
28-Nov-07	0.6460	0.64755	0.2407
29-Nov-07	0.6595	0.66109	0.2407
30-Nov-07	0.6377	0.63923	0.2407
01-Dec-07	0.6474	0.64896	0.2407
02-Dec-07	0.6486	0.65016	0.2407
03-Dec-07	0.6969	0.69858	0.2407
04-Dec-07	0.6375	0.63903	0.2407
05-Dec-07	0.5784	0.57979	0.2407
06-Dec-07	0.5659	0.56726	0.2407
07-Dec-07	0.6300	0.63152	0.2407
08-Dec-07	0.6626	0.66419	0.2407
09-Dec-07	0.6821	0.68374	0.2407
10-Dec-07	0.7611	0.76293	0.2407
11-Dec-07	0.7400	0.74178	0.2407
12-Dec-07	0.7689	0.77075	0.2407
13-Dec-07	0.7721	0.77396	0.2407
14-Dec-07	0.8256	0.82759	0.2407
15-Dec-07	0.7964	0.79832	0.2407
16-Dec-07	0.8076	0.80954	0.2407
17-Dec-07	0.8437	0.84573	0.2407
18-Dec-07	0.7816	0.78348	0.2407
19-Dec-07	0.7702	0.77205	0.2407
20-Dec-07	0.8735	0.87560	0.2407
21-Dec-07	0.8382	0.84022	0.2407
22-Dec-07	0.7488	0.75060	0.2407
23-Dec-07	0.7670	0.76885	0.2407
24-Dec-07	0.6882	0.68986	0.2407

25-Dec-07	0.6473	0.64886	0.2407
26-Dec-07	0.6666	0.66820	0.2407
27-Dec-07	0.6224	0.62390	0.2407
28-Dec-07	0.6161	0.61758	0.2407
29-Dec-07	0.6506	0.65217	0.2407
30-Dec-07	0.6325	0.63402	0.2407
31-Dec-07	0.6414	0.64294	0.2407
01-Jan-08	0.6397	0.64124	0.2407
02-Jan-08	0.7500	0.75181	0.2407
03-Jan-08	0.8427	0.84473	0.2407
04-Jan-08	0.7799	0.78178	0.2407
05-Jan-08	0.7195	0.72123	0.2407
06-Jan-08	0.7555	0.75732	0.2407
07-Jan-08	0.7795	0.78138	0.2407
08-Jan-08	0.7494	0.75120	0.2407
09-Jan-08	0.7866	0.78849	0.2407
10-Jan-08	0.7221	0.72384	0.2407
11-Jan-08	0.7458	0.74760	0.2407
12-Jan-08	0.7279	0.72965	0.2407
13-Jan-08	0.6840	0.68565	0.2407
14-Jan-08	0.7181	0.71983	0.2407
15-Jan-08	0.7024	0.70409	0.2407
16-Jan-08	0.7188	0.72053	0.2407
17-Jan-08	0.7329	0.73466	0.2407
18-Jan-08	0.6757	0.67733	0.2407
19-Jan-08	0.5897	0.59113	0.2407
20-Jan-08	0.5721	0.57348	0.2407
21-Jan-08	0.6436	0.64515	0.2407
22-Jan-08	0.7165	0.71822	0.2407
23-Jan-08	0.6623	0.66389	0.2407
24-Jan-08	0.7018	0.70349	0.2407
25-Jan-08	0.7150	0.71672	0.2407
26-Jan-08	0.6703	0.67191	0.2407
27-Jan-08	0.6546	0.65618	0.2407
28-Jan-08	0.7337	0.73547	0.2407
29-Jan-08	0.6986	0.70027	0.2407
30-Jan-08	0.7420	0.74379	0.2407
31-Jan-08	0.7752	0.77707	0.2407
01-Feb-08	0.7877	0.78960	0.2407
02-Feb-08	0.7884	0.79030	0.2407
03-Feb-08	0.7542	0.75602	0.2407
04-Feb-08	0.7430	0.74479	0.2407
05-Feb-08	0.6909	0.69256	0.2407
06-Feb-08	0.7124	0.71411	0.2407
07-Feb-08	0.7055	0.70720	0.2407
08-Feb-08	0.6511	0.65267	0.2407
09-Feb-08	0.6488	0.65036	0.2407
10-Feb-08	0.6613	0.66288	0.2407

11-Feb-08	0.7349	0.73667	0.2407
12-Feb-08	0.7213	0.72304	0.2407
13-Feb-08	0.7364	0.73817	0.2407
14-Feb-08	0.7835	0.78539	0.2407
15-Feb-08	0.8007	0.80263	0.2407
16-Feb-08	0.8100	0.81195	0.2407
17-Feb-08	0.8141	0.81606	0.2407
18-Feb-08	0.8391	0.84112	0.2407
19-Feb-08	0.8794	0.88152	0.2407
20-Feb-08	0.8275	0.82949	0.2407
21-Feb-08	0.7231	0.72484	0.2407
22-Feb-08	0.6350	0.63653	0.2407
23-Feb-08	0.6024	0.60385	0.2407
24-Feb-08	0.6170	0.61849	0.2407
25-Feb-08	0.7114	0.71311	0.2407
26-Feb-08	0.6520	0.65357	0.2407
27-Feb-08	0.6647	0.66630	0.2407
28-Feb-08	0.6700	0.67161	0.2407
29-Feb-08	0.6959	0.69758	0.2407
01-Mar-08	0.6331	0.63462	0.2407
02-Mar-08	0.6085	0.60996	0.2407
03-Mar-08	0.6898	0.69146	0.2407
04-Mar-08	0.7237	0.72544	0.2407
05-Mar-08	0.6990	0.70068	0.2407
06-Mar-08	0.6319	0.63342	0.2407
07-Mar-08	0.6091	0.61057	0.2407
08-Mar-08	0.6058	0.60726	0.2407
09-Mar-08	0.6027	0.60415	0.2407
10-Mar-08	0.7072	0.70890	0.2407
11-Mar-08	0.6784	0.68003	0.2407
12-Mar-08	0.7011	0.70279	0.2407
13-Mar-08	0.6775	0.67913	0.2407
14-Mar-08	0.5892	0.59062	0.2407
15-Mar-08	0.5286	0.52987	0.2407
16-Mar-08	0.6539	0.65547	0.2407
17-Mar-08	0.8175	0.81947	0.2407
18-Mar-08	0.8130	0.81496	0.2407
19-Mar-08	0.7261	0.72785	0.2407
20-Mar-08	0.7337	0.73547	0.2407
21-Mar-08	0.6994	0.70108	0.2407
22-Mar-08	0.7404	0.74218	0.2407
23-Mar-08	0.7563	0.75812	0.2407
24-Mar-08	0.7412	0.74298	0.2407
25-Mar-08	0.7456	0.74739	0.2407
26-Mar-08	0.7016	0.70329	0.2407
27-Mar-08	0.6500	0.65156	0.2407
28-Mar-08	0.6875	0.68915	0.2407
29-Mar-08	0.6409	0.64244	0.2407

30-Mar-08	0.5777	0.57909	0.2407
31-Mar-08	0.6251	0.62660	0.2407
01-Apr-08	0.5845	0.58591	0.2407
02-Apr-08	0.6021	0.60355	0.2407
03-Apr-08	0.5593	0.56065	0.2407
04-Apr-08	0.5454	0.54671	0.2407
05-Apr-08	0.6055	0.60696	0.2407
06-Apr-08	0.6595	0.66109	0.2407
07-Apr-08	0.7314	0.73316	0.2407
08-Apr-08	0.7183	0.72003	0.2407
09-Apr-08	0.6659	0.66750	0.2407
10-Apr-08	0.6325	0.63402	0.2407
11-Apr-08	0.6403	0.64184	0.2407
12-Apr-08	0.6035	0.60495	0.2407
13-Apr-08	0.6298	0.63132	0.2407
14-Apr-08	0.6647	0.66630	0.2407
15-Apr-08	0.6778	0.67943	0.2407
16-Apr-08	0.6902	0.69186	0.2407
17-Apr-08	0.7168	0.71853	0.2407
18-Apr-08	0.6838	0.68545	0.2407
19-Apr-08	0.6605	0.66209	0.2407
20-Apr-08	0.6459	0.64745	0.2407
21-Apr-08	0.5623	0.56365	0.2407
22-Apr-08	0.4845	0.48567	0.2407
23-Apr-08	0.4517	0.45279	0.2407
24-Apr-08	0.4823	0.48346	0.2407
25-Apr-08	0.4333	0.43434	0.2407
26-Apr-08	0.3843	0.38523	0.2407
27-Apr-08	0.4794	0.48055	0.2407
28-Apr-08	0.5406	0.54190	0.2407
29-Apr-08	0.5863	0.58771	0.2407
30-Apr-08	0.5441	0.54541	0.2407
01-May-08	0.4676	0.46873	0.2407
02-May-08	0.4800	0.48116	0.2407
03-May-08	0.3928	0.39375	0.2407
04-May-08	0.3594	0.36027	0.2407
05-May-08	0.3284	0.32919	0.2407
06-May-08	0.3510	0.35184	0.2407
07-May-08	0.3268	0.32759	0.2407
08-May-08	0.3179	0.31867	0.2407
09-May-08	0.3098	0.31055	0.2407
10-May-08	0.3104	0.31115	0.2407
11-May-08	0.3901	0.39104	0.2407
12-May-08	0.4115	0.41249	0.2407
13-May-08	0.4323	0.43334	0.2407
14-May-08	0.4465	0.44757	0.2407
15-May-08	0.4757	0.47685	0.2407
16-May-08	0.5183	0.51955	0.2407

17-May-08	0.5243	0.52556	0.2407
18-May-08	0.4938	0.49499	0.2407
19-May-08	0.5282	0.52947	0.2407
20-May-08	0.5016	0.50281	0.2407
21-May-08	0.4573	0.45840	0.2407
22-May-08	0.4409	0.44196	0.2407
23-May-08	0.4497	0.45078	0.2407
24-May-08	0.4378	0.43885	0.2407
25-May-08	0.5027	0.50391	0.2407
26-May-08	0.5142	0.51544	0.2407
27-May-08	0.5065	0.50772	0.2407
28-May-08	0.4853	0.48647	0.2407
29-May-08	0.4441	0.44517	0.2407
30-May-08	0.4357	0.43675	0.2407
31-May-08	0.3918	0.39274	0.2407
01-Jun-08	0.4256	0.42662	0.2407
02-Jun-08	0.4166	0.41760	0.2407
03-Jun-08	0.4454	0.44647	0.2407
04-Jun-08	0.4195	0.42051	0.2407
05-Jun-08	0.4097	0.41069	0.2407
06-Jun-08	0.4122	0.41319	0.2407
07-Jun-08	0.4041	0.40507	0.2407
08-Jun-08	0.3725	0.37340	0.2407
09-Jun-08	0.2756	0.27626	0.2407
10-Jun-08	0.2860	0.28669	0.2407
11-Jun-08	0.2958	0.29651	0.2407
12-Jun-08	0.3101	0.31085	0.2407
13-Jun-08	0.3231	0.32388	0.2407
14-Jun-08	0.3451	0.34593	0.2407
15-Jun-08	0.3579	0.35876	0.2407
16-Jun-08	0.3646	0.36548	0.2407
17-Jun-08	0.3617	0.36256	0.2407
18-Jun-08	0.3735	0.37440	0.2407
19-Jun-08	0.3580	0.35886	0.2407
20-Jun-08	0.3569	0.35776	0.2407
21-Jun-08	0.3770	0.37791	0.2407
22-Jun-08	0.3480	0.34884	0.2407
23-Jun-08	0.3608	0.36167	0.2407
24-Jun-08	0.3454	0.34623	0.2407
25-Jun-08	0.3630	0.36388	0.2407
26-Jun-08	0.3663	0.36718	0.2407
27-Jun-08	0.3635	0.36437	0.2407
28-Jun-08	0.3335	0.33430	0.2407
29-Jun-08	0.3519	0.35276	0.2407
30-Jun-08	0.3650	0.36588	0.2407
01-Jul-08	0.3419	0.34272	0.2407
02-Jul-08	0.3446	0.34543	0.2407
03-Jul-08	0.3637	0.36458	0.2407

04-Jul-08	0.3430	0.34383	0.2407
05-Jul-08	0.3388	0.33963	0.2407
06-Jul-08	0.3532	0.35405	0.2407
07-Jul-08	0.3710	0.37189	0.2407
08-Jul-08	0.3724	0.37330	0.2407
09-Jul-08	0.3967	0.39765	0.2407
10-Jul-08	0.3716	0.37249	0.2407
11-Jul-08	0.3605	0.36137	0.2407
12-Jul-08	0.3378	0.33861	0.2407
13-Jul-08	0.3304	0.33121	0.2407
14-Jul-08	0.3540	0.35485	0.2407
15-Jul-08	0.3304	0.33120	0.2407
16-Jul-08	0.3412	0.34202	0.2407
17-Jul-08	0.3557	0.35656	0.2407
18-Jul-08	0.3479	0.34874	0.2407
19-Jul-08	0.3274	0.32819	0.2407
20-Jul-08	0.3492	0.35004	0.2407
21-Jul-08	0.3458	0.34663	0.2407
22-Jul-08	0.3418	0.34262	0.2407
23-Jul-08	0.3283	0.32909	0.2407
24-Jul-08	0.3433	0.34413	0.2407
25-Jul-08	0.2930	0.29371	0.2407
26-Jul-08	0.3032	0.30393	0.2407
27-Jul-08	0.3634	0.36427	0.2407
28-Jul-08	0.3606	0.36147	0.2407
29-Jul-08	0.3716	0.37249	0.2407
30-Jul-08	0.3626	0.36347	0.2407
31-Jul-08	0.3651	0.36598	0.2407
01-Aug-08	0.3513	0.35215	0.2407
02-Aug-08	0.3453	0.34613	0.2407
03-Aug-08	0.3557	0.35656	0.2407
04-Aug-08	0.3700	0.37089	0.2407
05-Aug-08	0.3868	0.38773	0.2407
06-Aug-08	0.3657	0.36658	0.2407
07-Aug-08	0.3687	0.36959	0.2407
08-Aug-08	0.3661	0.36698	0.2407
09-Aug-08	0.3832	0.38412	0.2407
10-Aug-08	0.3777	0.37861	0.2407
11-Aug-08	0.3774	0.37831	0.2407
12-Aug-08	0.3850	0.38593	0.2407
13-Aug-08	0.4079	0.40889	0.2407
14-Aug-08	0.3956	0.39655	0.2407
15-Aug-08	0.3867	0.38763	0.2407
16-Aug-08	0.3802	0.38112	0.2407
17-Aug-08	0.3914	0.39234	0.2407
18-Aug-08	0.3959	0.39685	0.2407
19-Aug-08	0.4024	0.40337	0.2407
20-Aug-08	0.4011	0.40207	0.2407

21-Aug-08	0.3961	0.39705	0.2407
22-Aug-08	0.3986	0.39956	0.2407
23-Aug-08	0.3775	0.37841	0.2407
24-Aug-08	0.3839	0.38482	0.2407
25-Aug-08	0.3881	0.38903	0.2407
26-Aug-08	0.4093	0.41029	0.2407
27-Aug-08	0.4122	0.41319	0.2407
28-Aug-08	0.4076	0.40858	0.2407
29-Aug-08	0.3991	0.40006	0.2407
30-Aug-08	0.3873	0.38823	0.2407
31-Aug-08	0.4068	0.40778	0.2407
01-Sep-08	0.4352	0.43625	0.2407
02-Sep-08	0.4547	0.45579	0.2407
03-Sep-08	0.4481	0.44918	0.2407
04-Sep-08	0.4598	0.46091	0.2407
05-Sep-08	0.4536	0.45469	0.2407
06-Sep-08	0.4363	0.43735	0.2407
07-Sep-08	0.4337	0.43474	0.2407
08-Sep-08	0.4349	0.43595	0.2407
09-Sep-08	0.4489	0.44999	0.2407
10-Sep-08	0.4393	0.44035	0.2407
11-Sep-08	0.4332	0.43424	0.2407
12-Sep-08	0.4507	0.45178	0.2407
13-Sep-08	0.4068	0.40778	0.2407
14-Sep-08	0.4209	0.42191	0.2407
15-Sep-08	0.4420	0.44306	0.2407
16-Sep-08	0.4617	0.46281	0.2407
17-Sep-08	0.4662	0.46732	0.2407
18-Sep-08	0.4451	0.44617	0.2407
19-Sep-08	0.4182	0.41921	0.2407
20-Sep-08	0.4311	0.43214	0.2407
21-Sep-08	0.4408	0.44186	0.2407
22-Sep-08	0.4751	0.47624	0.2407
23-Sep-08	0.4948	0.49599	0.2407
24-Sep-08	0.4849	0.48607	0.2407
25-Sep-08	0.4755	0.47664	0.2407
26-Sep-08	0.4836	0.48476	0.2407
27-Sep-08	0.4715	0.47263	0.2407
28-Sep-08	0.4965	0.49770	0.2407
29-Sep-08	0.5306	0.53188	0.2407
30-Sep-08	0.5193	0.52055	0.2407
01-Oct-08	0.5284	0.52967	0.2407
02-Oct-08	0.5685	0.56987	0.2407
03-Oct-08	0.5177	0.51895	0.2407
04-Oct-08	0.5158	0.51704	0.2407
05-Oct-08	0.4812	0.48236	0.2407
06-Oct-08	0.5177	0.51895	0.2407
07-Oct-08	0.4427	0.44377	0.2407

08-Oct-08	0.5318	0.53308	0.2407
09-Oct-08	0.5736	0.57498	0.2407
10-Oct-08	0.5388	0.54010	0.2407
11-Oct-08	0.4957	0.49689	0.2407
12-Oct-08	0.4841	0.48527	0.2407
13-Oct-08	0.5088	0.51002	0.2407
14-Oct-08	0.5232	0.52446	0.2407
15-Oct-08	0.5487	0.55002	0.2407
16-Oct-08	0.5971	0.59854	0.2407
17-Oct-08	0.5828	0.58420	0.2407
18-Oct-08	0.5511	0.55243	0.2407
19-Oct-08	0.5521	0.55343	0.2407
20-Oct-08	0.5639	0.56526	0.2407
21-Oct-08	0.5972	0.59864	0.2407
22-Oct-08	0.6244	0.62590	0.2407
23-Oct-08	0.6194	0.62089	0.2407
24-Oct-08	0.5883	0.58972	0.2407
25-Oct-08	0.6645	0.66610	0.2407
26-Oct-08	0.5967	0.59814	0.2407
27-Oct-08	0.7087	0.71041	0.2407
28-Oct-08	0.7972	0.79912	0.2407
29-Oct-08	0.7913	0.79320	0.2407
30-Oct-08	0.8088	0.81075	0.2407
31-Oct-08	0.7903	0.79220	0.2407
01-Nov-08	0.7453	0.74709	0.2407
02-Nov-08	0.6606	0.66219	0.2407
03-Nov-08	0.6608	0.66239	0.2407
04-Nov-08	0.5960	0.59743	0.2407
05-Nov-08	0.6143	0.61578	0.2407
06-Nov-08	0.6081	0.60956	0.2407
07-Nov-08	0.5882	0.58962	0.2407
08-Nov-08	0.5736	0.57498	0.2407
09-Nov-08	0.6317	0.63322	0.2407
10-Nov-08	0.7018	0.70349	0.2407
11-Nov-08	0.6698	0.67141	0.2407
12-Nov-08	0.6525	0.65407	0.2407
13-Nov-08	0.6681	0.66971	0.2407
14-Nov-08	0.6075	0.60896	0.2407
15-Nov-08	0.6274	0.62891	0.2407
16-Nov-08	0.6589	0.66049	0.2407
17-Nov-08	0.7277	0.72945	0.2407
18-Nov-08	0.6768	0.67843	0.2407
19-Nov-08	0.5845	0.58591	0.2407
20-Nov-08	0.6201	0.62159	0.2407
21-Nov-08	0.6555	0.65708	0.2407
22-Nov-08	0.7277	0.72945	0.2407
23-Nov-08	0.7960	0.79792	0.2407
24-Nov-08	0.7760	0.77787	0.2407

25-Nov-08	0.7571	0.75892	0.2407
26-Nov-08	0.6619	0.66349	0.2407
27-Nov-08	0.6403	0.64184	0.2407
28-Nov-08	0.6860	0.68765	0.2407
29-Nov-08	0.7096	0.71131	0.2407
30-Nov-08	0.7320	0.73376	0.2407
01-Dec-08	0.7548	0.75662	0.2407
02-Dec-08	0.7438	0.74559	0.2407
03-Dec-08	0.7421	0.74389	0.2407
04-Dec-08	0.6960	0.69768	0.2407
05-Dec-08	0.6843	0.68595	0.2407
06-Dec-08	0.6558	0.65738	0.2407
07-Dec-08	0.7143	0.71602	0.2407
08-Dec-08	0.7515	0.75331	0.2407
09-Dec-08	0.7621	0.76393	0.2407
10-Dec-08	0.7770	0.77887	0.2407
11-Dec-08	0.7345	0.73627	0.2407
12-Dec-08	0.7563	0.75812	0.2407
13-Dec-08	0.6725	0.67412	0.2407
14-Dec-08	0.6711	0.67272	0.2407
15-Dec-08	0.6787	0.67905	0.0518