ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT AUDLEY (DUNKIRK)

A Report for

National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA

PROJECT NO: NGR010 **REPORT NO: 2010/333** **DATE: 6 SEPTEMBER 2010**

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A Report for

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Prepared by:	Approved by:
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for
Michael Valente
Managing Director

Date: 6 September 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 Audley (Dunkirk) a correction factor should be applied to the flow in MTE only as follows:

Meter tube	Date	Correction factor $q_{m,c}/q_{m,o}$
MTE	27/09/2007 to 12/06/2008	1.002440

Over the period 27/09/2007 to 12/06/2008 inclusive the flow and corrected flow in the two tubes were as follows:

	MTD	MTE
Flow (mscm)	96.47611	95.90157
Corrected flow (mscm)	96.47611	96.13460

CONTENTS

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 Audley (Dunkirk) in the period of the error. There was no error in meter tube MTD. The Joint Office Error Code is WM003 for meter tube MTE.

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	Orifice bore (mm)
OP50131	357-8	05/06/2006	104.3145	21	104.3128
OP60118	357-9	13/09/2006	104.3135	21	104.3118
OP70085	357-9	20/08/2007	104.214	20	104.2140
OP80021	357-8	06/06/2008	104.323	20	104.3230
OP80066	357-9	17/10/2008	104.3205	20.4	104.3198
OP90018	357-8	03/06/2009	104.327	20.4	104.3263

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 plates were mis-measured.

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

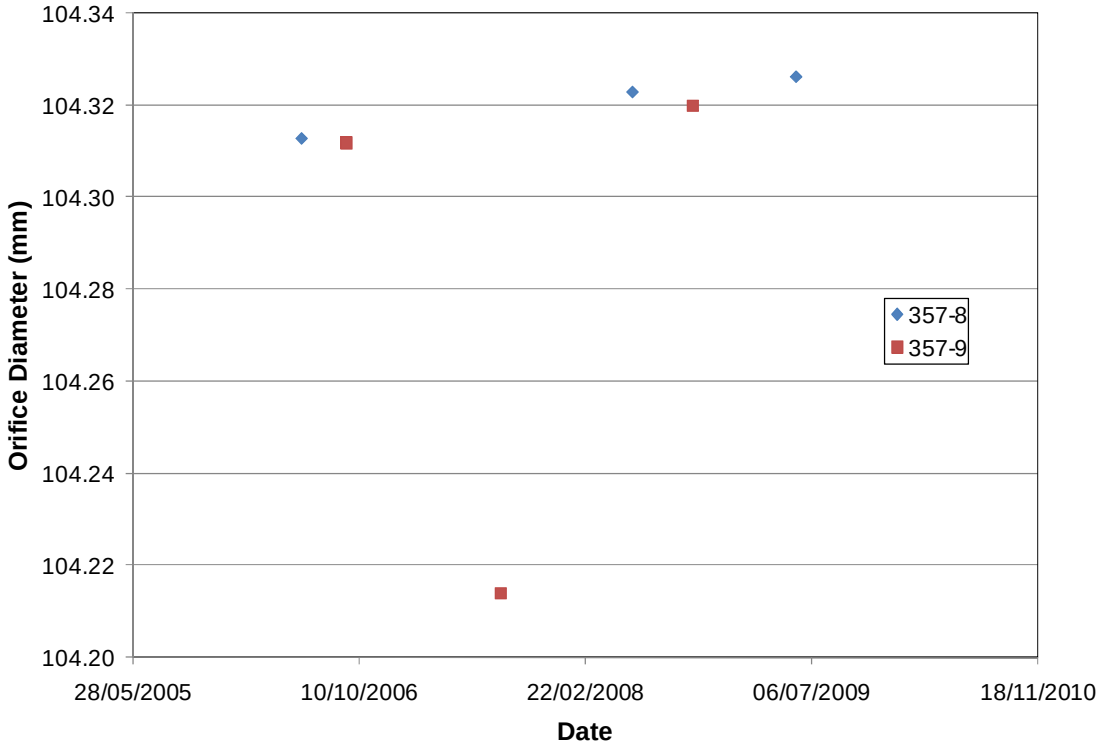

Figure 1 Orifice Diameters at 20 °C

The plates actually used in each of the two meter tubes are given in Table 2.

TABLE 2

PLATES USED IN EACH LINE AS CONFIGURED BY FLOW COMPUTER

Configuration data	omnM0619.cfg	omnM0927.cfg	omnN0612.cfg
MTD	19/06/2007 23:01	27/09/2007 23:01	12/06/2008 23:01
Orifice plate bore diameter (mm)	104.2925	104.2925	104.349
Expansion coefficient of the plate (/°C)	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	20
Meter tube diameter (mm)	154.2733	154.2733	154.2733
Expansion coefficient of the meter tube (/°C)	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20
Isentropic Exponent	1.3433	1.3433	1.3433
Dynamic Viscosity (Pa.s)	0.0000121	0.0000121	0.0000121
Orifice plate certificate number	Not specified	Not specified	Not specified
Orifice plate serial number	Not specified	Not specified	Not specified
Error in orifice diameter?	No	No	No
MTE			
Orifice plate bore diameter (mm)	104.3145	104.214	104.323
Expansion coefficient of the plate (/°C)	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	20
Meter tube diameter (mm)	154.0669	154.0669	154.0669
Expansion coefficient of the meter tube (/°C)	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20
Isentropic Exponent	1.3433	1.3433	1.3433
Dynamic Viscosity (Pa.s)	0.0000121	0.0000121	0.0000121
Orifice plate certificate number	OP50131	OP70085	OP80021
Orifice plate serial number	357-8	357-9	357-8
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 eight-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 orifice 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 59 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00004% at maximum.

Over the period from 27/09/2007 to 12/06/2008 the correction on MTE can be calculated as in Table 3. Throughout this calculation the meter tube diameter is 154.0669 mm, the isentropic exponent is 1.3433 and the dynamic viscosity is 0.0000121 Pa s.

TABLE 3

THE CORRECTION ON MTE FROM 27/09/2007 TO 12/06/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: Δp=10 mbar	104.214	0.676420	0.999939	1288558	0.604676	
Corrected Δp=10 mbar	104.3158	0.677081	0.999939	1291704	0.604655	1.0024415
Original Δp=500 mbar	104.214	0.676420	0.996951	9073821	0.603982	
Corrected Δp=500 mbar	104.3158	0.677081	0.996949	9095952	0.603961	1.0024390

So $q_{m,c}/q_{m,o}$ is 1.002440.

4 CORRECTIONS ON A DAILY BASIS

Each (approximately eight-minute) interval was considered and the flow (here and throughout this paragraph flow refers to standard volume flow) was calculated in each tube; the flowrate during the interval was taken as the average of that at the beginning and that at the end of the interval. The interval is only known to the nearest minute; so the flow in MTD during the interval was calculated by taking the product of the total flow (supplied by National Grid) during that interval and the ratio of the calculated flow in MTD to the sum of the calculated flows in the tubes. Intervals in which the calculated flow in both MTD and MTE is zero have been disregarded. Then on taking account of the effects at the beginning and end of each day the sum of the daily flow in MTD (obtained by summing the flows in each interval) and that in MTE (obtained the same way) should be equal to the total flow in that day. To ensure that the sum of the daily flows is exactly equal to the total daily flow the individual totals were scaled. Then the increase in daily flow was calculated for each of the two daily flows by using the percentage increase for each tube given above. Finally the total increase in the daily flow is the sum of the increases for the two tubes. The results are given in Table B.1 of Appendix B. The sum of the flows and the sum of the corrections have also been calculated by meter tube. It was assumed that on 27/09/2007 the orifice plate in MTE was changed at 11:30 and that on 12/06/2008 the orifice plates in MTD and MTE were changed at 11:30.

5 CONCLUSIONS

A correction factor to the flow in MTE only should be applied as shown in Table 4.

TABLE 4

CORRECTION FACTOR

Meter tube	Date	Correction factor $q_{m,c}/q_{m,o}$
MTE	27/09/2007 to 12/06/2008	1.002440

This correction factor applies to both measured volume and measured energy.

On applying this correction the corrected volumes are as shown in Appendix B.

Flows by meter tube are as shown in Table 5.

TABLE 5

FLOW IN THE PERIOD 27/09/2007 TO 12/06/2008 INCLUSIVE

	MTD	MTE
Flow (mscm)	96.47611	95.90157
Correction (mscm)	0	0.23303
Corrected flow (mscm)	96.47611	96.13460
% change	0	0.2430

APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: *05-06-06*

REF NO: *OP50131*

TEMPERATURE: *21 degsC*

MEASURED ORIFICE BORE: *104.3145mm*

PLATE DETAILS

PLATE SERIAL. 357-8 PLATE O.D 163.183mm
MANUFACTURER: PIPE I.D: mm SITE AUDLEY
MATERIAL CERT.No DESIGN BORE: mm 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 %	0.078	0.075	0.140	0.115	0.049	0.091	0.113	0.114
'E' mm	3.138	3.103	3.102	3.063	3.046	3.076	3.123	3.143
	2.076	2.069	2.075	2.086	2.054	2.072	2.103	2.083
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE 44 DEGS

CONCENTRICITY 0.033mm

SURFACE FINISH (Ra) 0.5 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION PASS

ROUNDNESS 0.006mm TAPER 0 degs

COMMENTS:

INSPECTED BY  J. CHAUHAN

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-09-06

REF NO: OP60118

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 104.3135mm

PLATE DETAILS

PLATE SERIAL. 357-9
MANUFACTURER: DANIEL
MATERIAL CERT.No.

PLATE O.D 163.473mm
PIPE I.D: mm
DESIGN BORE: mm

SITE: AUDLEY
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 %	0.108	0.020	0.223	0.234	0.039	0.018	0.170	0.165
'E' mm	3.281	3.282	3.286	3.290	3.287	3.268	3.273	3.285
'e' mm	2.671	2.801	2.779	2.786	2.749	2.687	2.687	2.755
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE: 35 DEGS

CONCENTRICITY 0.029mm

SURFACE FINISH (Ra) 0.8 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.009mm TAPER: 0 degs

COMMENTS:

INSPECTED BY..... P.KENNERSON / J. CHANHAN -

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 20-AUG-2007

REF NO: OP70085

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 104.214mm

PLATE DETAILS

PLATE SERIAL.	357-9	PLATE O.D	163.341mm		
MANUFACTURER:	DANIEL	PIPE I.D:	mm	SITE:	AUDLEY
MATERIAL CERT.No.		DESIGN BORE:	mm	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	5	6	7	8
FLATNESS %	0.140	0.014	0.076	0.023	0.100	0.139	0.007	0.060
'E' mm	3.320	3.322	3.276	3.274	3.329	3.334	3.267	3.270
'e' mm								
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	0.0125

BEVEL ANGLE: DEGS

CONCENTRICITY 0.013mm

SURFACE FINISH (Ra) 0.5 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION : PASS

ROUNDNESS : 0.082mm TAPER: 0 degs

COMMENTS:

INSPECTED BY..... M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 06-JUNE-2008

REF NO: OP80021

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 104.323mm

PLATE DETAILS

PLATE SERIAL.	357-8	PLATE O.D	163.188mm		
MANUFACTURER:		PIPE I.D:	154.0669mm	SITE:	AUDLEY
MATERIAL CERT.No.		DESIGN BORE:	mm	FLOW:	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	6	7	8
FLATNESS %	0.029	0.065	0.129	0.136	0.023	0.107	0.101	0.089
'E' mm	3.120	3.101	3.097	3.077	3.036	3.070	3.122	3.137
'e' mm	2.081	2.061	2.062	2.083	2.070	2.064	2.099	2.085
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	0.0125	SQUARE	SQUARE

BEVEL ANGLE: 44 DEGS

CONCENTRICITY 0.032mm

SURFACE FINISH (Ra) 0.57 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.010mm TAPER: 0 degs

COMMENTS: CLEAN PLATE

INSPECTED BY..... M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 17-OCT-2008

REF NO: OP80066

TEMPERATURE: 20.4 degsC

MEASURED ORIFICE BORE: 104.3205mm

PLATE DETAILS

PLATE SERIAL. 357-9
MANUFACTURER: DANIEL
MATERIAL CERT.No.

PLATE O.D 163.461mm
PIPE I.D: 154.0669mm SITE: AUDLEY
DESIGN BORE: mm FLOW: 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 %	0.130	0.012	0.136	0.052	0.147	0.167	0.081	0.026
'E' mm	3.286	3.260	3.266	3.280	3.274	3.274	3.285	3.281
'e' mm	2.694	2.732	2.737	2.724	2.706	2.611	2.709	2.764
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE

BEVEL ANGLE: 37 DEGS

CONCENTRICITY 0.018mm

SURFACE FINISH (Ra) 0.4 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.018mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE

INSPECTED BY..... M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 03-JUNE-2009

REF NO: OP90018

TEMPERATURE: 20.4 degsC

MEASURED ORIFICE BORE: 104.327mm

PLATE DETAILS

PLATE SERIAL.	357-8	PLATE O.D	163.176mm		
MANUFACTURER:		PIPE I.D:	154.0669mm	SITE:	AUDLEY
MATERIAL CERT.No.		DESIGN BORE:	mm	FLOW:	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 %	0.078	0.035	0.097	0.170	0.104	0.053	0.067	0.109
'E' mm	3.125	3.102	3.097	3.068	3.038	3.075	3.115	3.136
'e' mm	2.074	2.063	2.064	2.027	2.052	2.054	2.085	2.104
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	0.0125

BEVEL ANGLE: 44 DEGS

CONCENTRICITY 0.041mm

SURFACE FINISH (Ra) 0.58 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 AUDLEY (DUNKIRK) DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
27/9/2007	0.7896	**0.79030**	0.0888
28/9/2007	0.8019	**0.80287**	0.1212
29/9/2007	0.7916	**0.79256**	0.1212
30/9/2007	0.7182	**0.71907**	0.1212
1/10/2007	0.7132	**0.71407**	0.1213
2/10/2007	0.8858	**0.88687**	0.1212
3/10/2007	0.91209	**0.91320**	0.1212
4/10/2007	0.16621	**0.16641**	0.1212
5/10/2007	0.73289	**0.73378**	0.1213
6/10/2007	0.82	**0.82099**	0.1212
7/10/2007	0.1446	**0.14478**	0.1212
8/10/2007	0.059	**0.05907**	0.1212
9/10/2007	0.0855	**0.08560**	0.1215
10/10/2007	0.9417	**0.94284**	0.1212
11/10/2007	0.9047	**0.90580**	0.1212
12/10/2007	0.83089	**0.83190**	0.1212
13/10/2007	0.74641	**0.74731**	0.1212
14/10/2007	0.9767	**0.97788**	0.1212
15/10/2007	0.9527	**0.95385**	0.1212
16/10/2007	0.7597	**0.76062**	0.1212
17/10/2007	0.8629	**0.86395**	0.1212
18/10/2007	0.7217	**0.72257**	0.1212
19/10/2007	0.9213	**0.92242**	0.1212
20/10/2007	1.0329	**1.03415**	0.1212
21/10/2007	0.9715	**0.97268**	0.1212
22/10/2007	1.1706	**1.17202**	0.1212
23/10/2007	0.311	**0.31138**	0.1212
24/10/2007	0.6252	**0.62596**	0.1211
25/10/2007	0.406	**0.40649**	0.1212
26/10/2007	0.3293	**0.32970**	0.1213
27/10/2007	0.0003	**0.00030**	0.1207
28/10/2007	0	**0.00000**	
29/10/2007	0.4727	**0.47328**	0.1217
30/10/2007	0.5287	**0.52934**	0.1217
31/10/2007	0.3958	**0.39628**	0.1217
1/11/2007	0.6342	**0.63497**	0.1217
2/11/2007	0.1357	**0.13587**	0.1217
3/11/2007	0.1354	**0.13556**	0.1217
4/11/2007	0.2213	**0.22157**	0.1217
5/11/2007	0.6451	**0.64589**	0.1217
6/11/2007	0.401	**0.40149**	0.1217
7/11/2007	0.4617	**0.46226**	0.1217
8/11/2007	0.58	**0.58071**	0.1217
9/11/2007	0.5484	**0.54907**	0.1217
10/11/2007	0.2259	**0.22617**	0.1216

11/11/2007	0.2207	**0.22097**	0.1217
12/11/2007	0.7831	**0.78405**	0.1217
13/11/2007	0.6157	**0.61645**	0.1218
14/11/2007	0.6973	**0.69815**	0.1217
15/11/2007	0.7449	**0.74581**	0.1218
16/11/2007	0.7603	**0.76123**	0.1218
17/11/2007	0.5415	**0.54216**	0.1217
18/11/2007	0.8388	**0.83982**	0.1218
19/11/2007	0.9882	**0.98940**	0.1218
20/11/2007	0.9471	**0.94825**	0.1218
21/11/2007	1.0456	**1.04687**	0.1217
22/11/2007	1.1068	**1.10815**	0.1217
23/11/2007	1.1619	**1.16331**	0.1218
24/11/2007	0.998	**0.99921**	0.1217
25/11/2007	0.747	**0.74791**	0.1217
26/11/2007	0.7811	**0.78205**	0.1217
27/11/2007	0.797	**0.79797**	0.1217
28/11/2007	0.7804	**0.78135**	0.1218
29/11/2007	0.8158	**0.81679**	0.1218
30/11/2007	0.7266	**0.72748**	0.1218
1/12/2007	0.6385	**0.63928**	0.1217
2/12/2007	0.6504	**0.65119**	0.1217
3/12/2007	0.8214	**0.82240**	0.1218
4/12/2007	0.6697	**0.67052**	0.1217
5/12/2007	0.648	**0.64879**	0.1217
6/12/2007	0.6348	**0.63557**	0.1217
7/12/2007	0.912	**0.91311**	0.1217
8/12/2007	1.0403	**1.04157**	0.1217
9/12/2007	1.0712	**1.07250**	0.1217
10/12/2007	0.9635	**0.96467**	0.1218
11/12/2007	0.8397	**0.84072**	0.1218
12/12/2007	0.9385	**0.93964**	0.1218
13/12/2007	0.9258	**0.92693**	0.1217
14/12/2007	1.1734	**1.17483**	0.1217
15/12/2007	1.1065	**1.10785**	0.1218
16/12/2007	1.1082	**1.10955**	0.1218
17/12/2007	1.1821	**1.18354**	0.1218
18/12/2007	1.1391	**1.14049**	0.1218
19/12/2007	1.1162	**1.11756**	0.1218
20/12/2007	1.2401	**1.24161**	0.1214
21/12/2007	0.9785	**0.97969**	0.1218
22/12/2007	0.5725	**0.57320**	0.1216
23/12/2007	0.7472	**0.74811**	0.1217
24/12/2007	0.6532	**0.65399**	0.1217
25/12/2007	0.7375	**0.73840**	0.1217
26/12/2007	0.6718	**0.67262**	0.1217
27/12/2007	0.6571	**0.65790**	0.1217
28/12/2007	0.846	**0.84703**	0.1217
29/12/2007	0.8382	**0.83922**	0.1217
30/12/2007	0.7668	**0.76773**	0.1217
31/12/2007	0.703	**0.70386**	0.1217
1/1/2008	0.6497	**0.65049**	0.1217
2/1/2008	0.83	**0.83101**	0.1218
3/1/2008	1.1716	**1.17302**	0.1214
4/1/2008	1.0928	**1.09413**	0.1217
5/1/2008	0.755	**0.75592**	0.1217
6/1/2008	0.8117	**0.81269**	0.1217

7/1/2008	1.0877	**1.08902**	0.1217
8/1/2008	0.9749	**0.97609**	0.1217
9/1/2008	0.8712	**0.87226**	0.1217
10/1/2008	0.8267	**0.82771**	0.1217
11/1/2008	0.8933	**0.89439**	0.1217
12/1/2008	0.7285	**0.72939**	0.1218
13/1/2008	0.8289	**0.82991**	0.1217
14/1/2008	0.7651	**0.76603**	0.1218
15/1/2008	0.843	**0.84403**	0.1218
16/1/2008	0.9081	**0.90921**	0.1217
17/1/2008	0.9937	**0.99491**	0.1217
18/1/2008	1.1094	**1.11075**	0.1217
19/1/2008	0.9012	**0.90230**	0.1217
20/1/2008	0.9306	**0.93173**	0.1217
21/1/2008	0.8657	**0.86675**	0.1218
22/1/2008	0.8594	**0.86045**	0.1218
23/1/2008	0.8311	**0.83211**	0.1217
24/1/2008	0.8124	**0.81339**	0.1218
25/1/2008	0.9765	**0.97769**	0.1217
26/1/2008	0.8648	**0.86585**	0.1217
27/1/2008	0.9421	**0.94325**	0.1217
28/1/2008	1.03989	**1.04115**	0.1213
29/1/2008	1.0156	**1.01684**	0.1217
30/1/2008	0.8785	**0.87957**	0.1217
31/1/2008	1.0119	**1.01313**	0.1218
1/2/2008	0.8923	**0.89339**	0.1218
2/2/2008	0.8967	**0.89779**	0.1218
3/2/2008	0.8716	**0.87266**	0.1218
4/2/2008	1.1236	**1.12497**	0.1218
5/2/2008	1.1624	**1.16381**	0.1212
6/2/2008	0.8523	**0.85334**	0.1218
7/2/2008	0.7506	**0.75151**	0.1218
8/2/2008	0.7697	**0.77064**	0.1218
9/2/2008	0.7616	**0.76253**	0.1217
10/2/2008	0.7502	**0.75111**	0.1217
11/2/2008	0.9913	**0.99251**	0.1218
12/2/2008	0.9726	**0.97378**	0.1217
13/2/2008	0.9823	**0.98349**	0.1214
14/2/2008	1.0441	**1.04537**	0.1218
15/2/2008	1.1218	**1.12317**	0.1218
16/2/2008	1.1433	**1.14469**	0.1218
17/2/2008	1.1241	**1.12547**	0.1218
18/2/2008	1.1647	**1.16612**	0.1218
19/2/2008	1.202	**1.20346**	0.1218
20/2/2008	1.2419	**1.24341**	0.1218
21/2/2008	1.0806	**1.08192**	0.1218
22/2/2008	0.9584	**0.95957**	0.1217
23/2/2008	1.0165	**1.01774**	0.1217
24/2/2008	1.1052	**1.10655**	0.1217
25/2/2008	1.1177	**1.11906**	0.1217
26/2/2008	0.9615	**0.96267**	0.1217
27/2/2008	0.9203	**0.92142**	0.1217
28/2/2008	1.0351	**1.03636**	0.1217
29/2/2008	0.9976	**0.99881**	0.1217
1/3/2008	1.026	**1.02725**	0.1217
2/3/2008	0.9625	**0.96367**	0.1217
3/3/2008	1.0576	**1.05889**	0.1218

4/3/2008	1.0603	**1.06159**	0.1218
5/3/2008	0.8604	**0.86145**	0.1218
6/3/2008	0.732	**0.73289**	0.1217
7/3/2008	0.9518	**0.95296**	0.1217
8/3/2008	0.7787	**0.77965**	0.1214
9/3/2008	0.7228	**0.72368**	0.1217
10/3/2008	1.081	**1.08232**	0.1217
11/3/2008	1.006	**1.00722**	0.1217
12/3/2008	1.0775	**1.07881**	0.1217
13/3/2008	0.9652	**0.96637**	0.1217
14/3/2008	0.6922	**0.69304**	0.1217
15/3/2008	0.9686	**0.96977**	0.1212
16/3/2008	0.8202	**0.82120**	0.1217
17/3/2008	0.9836	**0.98480**	0.1217
18/3/2008	1.0376	**1.03886**	0.1217
19/3/2008	0.8135	**0.81449**	0.1217
20/3/2008	0.9454	**0.94655**	0.1217
21/3/2008	0.8704	**0.87146**	0.1216
22/3/2008	0.6951	**0.69595**	0.1216
23/3/2008	0.7998	**0.80077**	0.1217
24/3/2008	0.9771	**0.97829**	0.1216
25/3/2008	1.0459	**1.04717**	0.1217
26/3/2008	0.9265	**0.92763**	0.1217
27/3/2008	1.009	**1.01022**	0.1212
28/3/2008	0.8207	**0.82170**	0.1217
29/3/2008	0.7356	**0.73649**	0.1216
30/3/2008	0.5823	**0.58301**	0.1217
31/3/2008	0.86	**0.86104**	0.1211
1/4/2008	0.9244	**0.92553**	0.1217
2/4/2008	0.9892	**0.99040**	0.1216
3/4/2008	0.8522	**0.85324**	0.1216
4/4/2008	0.6835	**0.68433**	0.1217
5/4/2008	0.8876	**0.88868**	0.1216
6/4/2008	1.012	**1.01323**	0.1217
7/4/2008	1.0714	**1.07270**	0.1217
8/4/2008	0.9968	**0.99801**	0.1217
9/4/2008	0.9313	**0.93243**	0.1217
10/4/2008	0.9482	**0.94935**	0.1217
11/4/2008	1.0035	**1.00472**	0.1217
12/4/2008	1.0441	**1.04537**	0.1216
13/4/2008	0.9592	**0.96037**	0.1217
14/4/2008	0.7374	**0.73830**	0.1216
15/4/2008	0.8507	**0.85173**	0.1216
16/4/2008	0.7145	**0.71537**	0.1216
17/4/2008	0.6777	**0.67852**	0.1217
18/4/2008	0.8662	**0.86725**	0.1216
19/4/2008	0.9093	**0.91041**	0.1216
20/4/2008	0.905	**0.90610**	0.1216
21/4/2008	0.8182	**0.81920**	0.1217
22/4/2008	0.7416	**0.74250**	0.1212
23/4/2008	0.8236	**0.82460**	0.1217
24/4/2008	0.6158	**0.61655**	0.1217
25/4/2008	0.9275	**0.92863**	0.1216
26/4/2008	0.6896	**0.69044**	0.1217
27/4/2008	0.8669	**0.86795**	0.1216
28/4/2008	0.812	**0.81299**	0.1217
29/4/2008	0.8119	**0.81289**	0.1217

30/4/2008	0.7866	**0.78756**	0.1216
1/5/2008	0.7146	**0.71547**	0.1217
2/5/2008	0.905	**0.90610**	0.1217
3/5/2008	0.5532	**0.55387**	0.1217
4/5/2008	0.8479	**0.84893**	0.1216
5/5/2008	0.9313	**0.93243**	0.1217
6/5/2008	0.818	**0.81900**	0.1217
7/5/2008	0.8194	**0.82040**	0.1217
8/5/2008	0.8397	**0.84072**	0.1217
9/5/2008	0.3731	**0.37355**	0.1217
10/5/2008	0	**0.00000**	
11/5/2008	0	**0.00000**	
12/5/2008	0.0717	**0.07179**	0.1219
13/5/2008	0.0001	**0.00010**	0.1220
14/5/2008	0	**0.00000**	
15/5/2008	0.0011	**0.00110**	0.1220
16/5/2008	0.0045	**0.00451**	0.1225
17/5/2008	0	**0.00000**	
18/5/2008	0	**0.00000**	
19/5/2008	0	**0.00000**	
20/5/2008	0	**0.00000**	
21/5/2008	0	**0.00000**	
22/5/2008	0	**0.00000**	
23/5/2008	0	**0.00000**	
24/5/2008	0	**0.00000**	
25/5/2008	0	**0.00000**	
26/5/2008	0	**0.00000**	
27/5/2008	0	**0.00000**	
28/5/2008	0	**0.00000**	
29/5/2008	0	**0.00000**	
30/5/2008	0	**0.00000**	
31/5/2008	0	**0.00000**	
1/6/2008	0	**0.00000**	
2/6/2008	0.8294	**0.83041**	0.1217
3/6/2008	1.0533	**1.05458**	0.1217
4/6/2008	0.9771	**0.97829**	0.1217
5/6/2008	0.1508	**0.15098**	0.1216
6/6/2008	0	**0.00000**	
7/6/2008	0.0001	**0.00010**	0.1220
8/6/2008	0	**0.00000**	
9/6/2008	0.0277	**0.02773**	0.1215
10/6/2008	0.5595	**0.56018**	0.1210
11/6/2008	0.8073	**0.80828**	0.1217
12/6/2008	0.7257	**0.72587**	0.0229