ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT ALREWAS EM

A Report for

National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA

PROJECT NO: NGR010 **REPORT NO: 2010/237** **DATE: 16 JUNE 2010**

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A Report for

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LE10 0NA

Prepared by:	Approved by:
M.J. Reader-Harris	J M McNaught
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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 Alrewas EM a correction factor of 1.002557 should be applied during the period of mis-measurement.

Over the period 19/06/2008 to 07/05/2009 inclusive the flow was 1694.79885 mscm and the corrected flow should be 1699.12284 mscm.

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 Alrewas EM in the period of the error. The Joint Office Error Code is EM001.

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

					Value at 20 °C
Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature	Orifice bore (mm)
OP4150	ALRE 5036	26/04/2005	310.0120	21	310.0070
OP50089	295-5	22/05/2006	310.0105	21	310.0055
OP60114	ALRE 5036	04/04/2007	310.0125	21	310.0075
OP70061	295-5	13/06/2007	309.7120	21	309.7070
OP80063	ALRE 5036	01/10/2008	310.0185	19	310.0235
OP90046	295-5	06/11/2009	310.0160	20.4	310.0140

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.

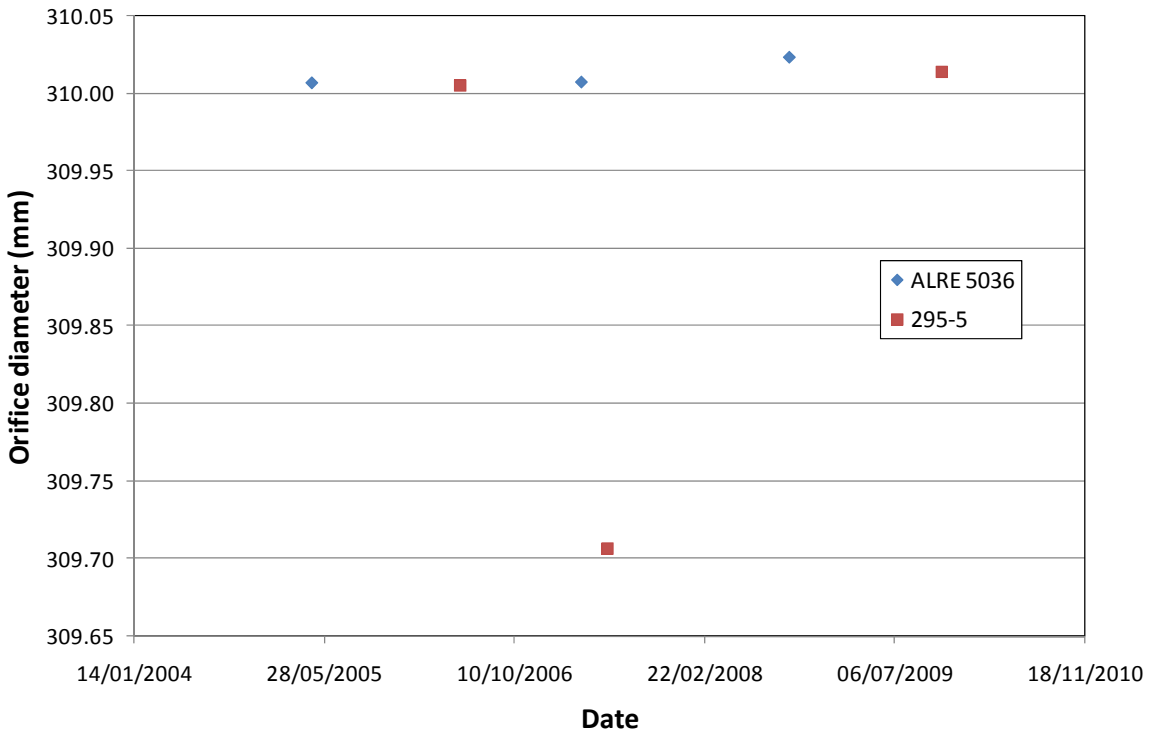

Figure 1 Orifice Diameters at 20 °C

The plates actually used in the meter tube are given in Table 2. No calibration data were given for OP80063 but it is assumed that this was not an erroneous calibration.

TABLE 2

PLATES USED IN EACH LINE AS CONFIGURED BY THE FLOW COMPUTER

Configuration	omnN0611.cfg	omnN0619.cfg	omnO0507.cfg
	11/06/2008 23:01	19/06/2008 23:01	07/05/2009 23:01
Orifice plate bore diameter (mm)	310.0125	309.712	310.0185
Expansion coefficient of the plate (/°C)	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	19
Meter tube diameter (mm)	432.2096	432.2096	432.2096
Expansion coefficient of the meter tube (/°C)	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20
Isentropic Exponent	1.3469	1.3469	1.3469
Dynamic Viscosity (Pa.s)	0.000012	0.000012	0.000012
Orifice plate certificate number	OP60114	OP70061	OP80063
Orifice plate serial number	ALRE 5036	295-5	
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 approximately twenty-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 59 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00005% at maximum.

Over the period from 19/06/2008 to 07/05/2009 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 432.2096 mm, the isentropic exponent is 1.3469 and the dynamic viscosity 0.000012 Pa s.

TABLE 3

THE CORRECTION FROM 19/06/2008 TO 07/05/2009

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: Δp=10 mbar	309.707	0.716567	0.999937	4238895	0.600197	
Corrected Δp=10 mbar	310.0098	0.717267	0.999937	4249739	0.600136	1.0025581
Original Δp=500 mbar	309.707	0.716567	0.996840	29864340	0.599869	
Corrected Δp=500 mbar	310.0098	0.717267	0.996837	29940660	0.599808	1.0025556

So $q_{m,c}/q_{m,o}$ is 1.002557.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 19/06/2008 to 07/05/2009 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 10:30 on 19/06/2008 and 16:00 on 07/05/2009. Therefore 83.1% of the flow for 19/06/2008 has to be corrected and 44.3% for 07/05/2009 based on the flow before and after the plate change. Summing the data gives the figures in Table 4.

TABLE 4

THE FLOW OVER THE PERIOD 19/06/2008 TO 07/05/2009 INCLUSIVE

Flow (mscm)	1694.79885
Correction (mscm)	4.32399
Corrected flow (mscm)	1699.12284
% change	0.2551

5 CONCLUSIONS

A correction factor of 1.002557 should be applied during the period of mis-measurement.

APPENDIX A
ORIFICE PLATE CALIBRATION CERTIFICATES

TRANSCO ORIFICE PLATE CALIBRATION

DATE: *26-04-05*

REF NO: *OP4150*

TEMPERATURE: *21 degsC*

MEASURED ORIFICE BORE: *310.012mm*

PLATE DETAILS

PLATE SERIAL.	ALRE 5036	PLATE O.D	507.987mm		
MANUFACTURER:		PIPE I.D:	432.206mm	SITE:	ALREWAS
MATERIAL CERT.No.		DESIGN BORE:	310.00mm	FLOW:	16 x 10e6 M^3/day

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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 %	0.011	0.018	0.043	0.013	0.041	0.034	0.020	0.042
'E' mm	9.374	9.355	9.329	9.332	9.361	9.322	9.344	9.337
mm	7.436	7.451	7.423	7.403	7.376	7.353	7.383	7.425
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE: 44 DEGS

CONCENTRICITY 0.101mm

SURFACE FINISH (Ra) 1.0 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.012mm TAPER: 0 degs

COMMENTS:

INSPECTED BY..... G.WARDLE

VERIFIED BY... P.KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 22-05-06

REF NO: OP50089

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 310.0105mm

PLATE DETAILS

PLATE SERIAL.	295-5	PLATE O.D	508.005mm		
MANUFACTURER:		PIPE I.D:	432.206mm	SITE:	ALREWAS
MATERIAL CERT.No.		DESIGN BORE:	310.00mm	FLOW:	16X10E06 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 %	0.127	0.122	0.128	0.124	0.101	0.126	0.122	0.070
'E' mm	9.159	9.160	9.149	9.118	9.127	9.129	9.141	9.162
'e' mm	7.011	7.055	7.000	6.942	6.960	6.931	6.981	7.009
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE 44 DEGS

CONCENTRICITY 0.050mm

SURFACE FINISH (Ra) 1.5 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.010mm TAPER: 0 degs

COMMENTS:

INSPECTED BY ..... P.KENNERSON J. CHAUHAN

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 04-04-07

REF NO: OP60114

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 310.0125mm

PLATE DETAILS

PLATE SERIAL.	ALRE5036	PLATE O.D	507.995mm		
MANUFACTURER:		PIPE I.D:	432.2064mm	SITE:	ALREWAS
MATERIAL CERT.No		DESIGN BORE	mm	FLOW:	16*10E06M^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		4	5	6		8
FLATNESS %	0.026	0.025	0.045	0.023	0.040	0.045	0.026	0.036
'E' mm	9.375	9.331	9.327	9.359	9.360	9.307	9.358	9.370
'e' mm	7.451	7.439	7.433	7.390	7.384	7.362	7.398	7.428
EDGE SHARPNESS mm	SQUARE	0.0125	SQUARE	0.0125	SQUARE	SQUARE	0.0125	SQUARE

BEVEL ANGLE 44 DEGS

CONCENTRICITY 0.088mm

SURFACE FINISH (Ra) 1.0 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.012mm TAPER: 0 degs

COMMENTS:

INSPECTED BY P.KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-06-07

REF NO: OP70061

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 309.712mm

PLATE DETAILS

PLATE SERIAL.	295-5	PLATE O.D	507.553mm		
MANUFACTURER:		PIPE I.D:	mm	SITE:	ALREWAS
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	
FLATNESS %	0.113	0.131	0.120	0.107	0.122	0.128	0.118	
'E' mm	9.211	9.139	9.129	9.173	9.186	9.112	9.129	
'e' mm	7.078	7.032	6.983	6.969	6.967	6.925	6.966	
EDGE SHARPNESS mm	0.0125	0.0125	0125	0.025	0.025	0.0125	0.0125	0.0125

BEVEL ANGLE 44 DEGS

CONCENTRICITY 0.082mm

SURFACE FINISH (Ra) 1.0 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.276mm TAPER: 0 degs

COMMENTS:

INSPECTED BY P. ROBINSON J. CHAWMAN

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 01-OCT-2008

REF NO: OP80063

TEMPERATURE: 19 degsC

MEASURED ORIFICE BORE: 310.0185mm

PLATE DETAILS

PLATE SERIAL.	ALRE 5036	PLATE O.D	507.985mm		
MANUFACTURER:		PIPE I.D:	432.2096mm	SITE:	ALREWAS
MATERIAL CERT.No.		DESIGN BORE:	mm	FLOW:	16X10E06 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:- 6292. NEXT CAL DUE:- 05-OCTOBER-2008

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.022	0.005	0.028	0.013	0.034	0.033	0.014	0.038
'E' mm	9.370	9.355	9.328	9.336	9.354	9.322	9.364	9.329
'e' mm	7.436	7.440	7.424	7.409	7.369	7.367	7.397	7.421
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	0.0125	SQUARE	0.0125	0.0125	SQUARE

BEVEL ANGLE: 44 DEGS

CONCENTRICITY 0.089mm

SURFACE FINISH (Ra) 0.8 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS : 0.009mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE.

INSPECTED BY..... M Livingstone.

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 6-NOV-2009

REF NO: OP90046

TEMPERATURE: 20.3 degsC

MEASURED ORIFICE BORE: 310.016mm

PLATE DETAILS

PLATE SERIAL.	295-5	PLATE O.D	508.004mm		
MANUFACTURER:	HEECO	PIPE I.D:	432.2096mm	SITE	ALREWAS EM
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 TRACEABLE CERT:- 7325. NEXT CAL DUE:- 02-OCTOBER-2010

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6		8
FLATNESS %	0.100	0.116	0.121	0.117	0.090	0.109	0.094	0.091
	9.155	9.159	9.148	9.109	9.128	9.128	9.136	9.162
e' mm	7.012	7.040	6.978	6.925	6.924	6.908	6.948	7.022
EDGE SHARPNESS mm	0.025	0.025	0.025	0.025	0.0125	0.0125	0.025	0.025

BEVEL ANGLE: 44 DEGS

CONCENTRICITY 0.043mm

SURFACE FINISH (Ra) 0.65 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 ALREWAS EM DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
19-Jun-08	4.72380	**4.73383**	0.2124
20-Jun-08	5.46000	**5.47396**	0.2557
21-Jun-08	6.00200	**6.01735**	0.2557
22-Jun-08	4.63300	**4.64485**	0.2557
23-Jun-08	5.90500	**5.92010**	0.2557
24-Jun-08	4.99200	**5.00476**	0.2557
25-Jun-08	5.34200	**5.35566**	0.2557
26-Jun-08	5.39000	**5.40378**	0.2557
27-Jun-08	4.97301	**4.98573**	0.2557
28-Jun-08	3.99400	**4.00421**	0.2557
29-Jun-08	3.99200	**4.00221**	0.2557
30-Jun-08	4.73000	**4.74209**	0.2557
01-Jul-08	4.01400	**4.02426**	0.2557
02-Jul-08	4.31100	**4.32202**	0.2557
03-Jul-08	4.49400	**4.50549**	0.2557
04-Jul-08	4.71700	**4.72906**	0.2557
05-Jul-08	4.27000	**4.28092**	0.2557
06-Jul-08	4.54100	**4.55261**	0.2557
07-Jul-08	4.93600	**4.94862**	0.2557
08-Jul-08	5.84400	**5.85894**	0.2557
09-Jul-08	5.77200	**5.78676**	0.2557
10-Jul-08	4.52600	**4.53757**	0.2557
11-Jul-08	4.88399	**4.89648**	0.2557
12-Jul-08	4.69200	**4.70400**	0.2557
13-Jul-08	4.46001	**4.47141**	0.2557
14-Jul-08	4.52400	**4.53557**	0.2557
15-Jul-08	4.38699	**4.39821**	0.2557
16-Jul-08	5.06300	**5.07595**	0.2557
17-Jul-08	6.10001	**6.11561**	0.2557
18-Jul-08	5.62399	**5.63837**	0.2557
19-Jul-08	5.07600	**5.08898**	0.2557
20-Jul-08	4.98599	**4.99874**	0.2557
21-Jul-08	4.95700	**4.96968**	0.2557
22-Jul-08	4.48900	**4.50048**	0.2557
23-Jul-08	4.72501	**4.73709**	0.2557
24-Jul-08	3.98601	**3.99620**	0.2557
25-Jul-08	4.09200	**4.10246**	0.2557
26-Jul-08	3.57100	**3.58013**	0.2557
27-Jul-08	3.49899	**3.50794**	0.2557
28-Jul-08	3.41501	**3.42374**	0.2557

29-Jul-08	3.48700	**3.49592**	0.2557
30-Jul-08	3.48700	**3.49592**	0.2557
31-Jul-08	3.37199	**3.38061**	0.2557
01-Aug-08	3.29100	**3.29942**	0.2557
02-Aug-08	2.99501	**3.00267**	0.2557
03-Aug-08	3.58600	**3.59517**	0.2557
04-Aug-08	3.31099	**3.31946**	0.2557
05-Aug-08	3.44501	**3.45382**	0.2557
06-Aug-08	3.29100	**3.29942**	0.2557
07-Aug-08	3.28900	**3.29741**	0.2557
08-Aug-08	3.45001	**3.45883**	0.2557
09-Aug-08	3.50098	**3.50993**	0.2557
10-Aug-08	3.49503	**3.50397**	0.2557
11-Aug-08	3.99500	**4.00522**	0.2557
12-Aug-08	4.46198	**4.47339**	0.2557
13-Aug-08	4.42001	**4.43131**	0.2557
14-Aug-08	4.19101	**4.20173**	0.2557
15-Aug-08	4.39899	**4.41024**	0.2557
16-Aug-08	3.83902	**3.84884**	0.2557
17-Aug-08	3.78799	**3.79768**	0.2557
18-Aug-08	4.42798	**4.43930**	0.2557
19-Aug-08	4.48401	**4.49548**	0.2557
20-Aug-08	4.43301	**4.44435**	0.2557
21-Aug-08	4.48898	**4.50046**	0.2557
22-Aug-08	4.48901	**4.50049**	0.2557
23-Aug-08	3.89999	**3.90996**	0.2557
24-Aug-08	3.50400	**3.51296**	0.2557
25-Aug-08	3.66299	**3.67236**	0.2557
26-Aug-08	3.63202	**3.64131**	0.2557
27-Aug-08	3.47198	**3.48086**	0.2557
28-Aug-08	3.33701	**3.34554**	0.2557
29-Aug-08	3.42099	**3.42974**	0.2557
30-Aug-08	3.47501	**3.48390**	0.2557
31-Aug-08	3.29700	**3.30543**	0.2557
01-Sep-08	3.63901	**3.64831**	0.2557
02-Sep-08	4.69601	**4.70802**	0.2557
03-Sep-08	5.06000	**5.07294**	0.2557
04-Sep-08	4.61899	**4.63080**	0.2557
05-Sep-08	4.99802	**5.01080**	0.2557
06-Sep-08	4.99500	**5.00777**	0.2557
07-Sep-08	5.06100	**5.07394**	0.2557
08-Sep-08	5.46698	**5.48096**	0.2557
09-Sep-08	6.22400	**6.23991**	0.2557
10-Sep-08	5.49100	**5.50504**	0.2557
11-Sep-08	4.99701	**5.00979**	0.2557
12-Sep-08	5.56299	**5.57721**	0.2557
13-Sep-08	4.86502	**4.87746**	0.2557
14-Sep-08	5.17700	**5.19024**	0.2557

15-Sep-08	5.68799	**5.70253**	0.2557
16-Sep-08	6.45200	**6.46850**	0.2557
17-Sep-08	6.37701	**6.39332**	0.2557
18-Sep-08	4.92300	**4.93559**	0.2557
19-Sep-08	4.66898	**4.68092**	0.2557
20-Sep-08	4.54602	**4.55764**	0.2557
21-Sep-08	4.46100	**4.47241**	0.2557
22-Sep-08	6.23801	**6.25396**	0.2557
23-Sep-08	6.32397	**6.34014**	0.2557
24-Sep-08	5.60400	**5.61833**	0.2557
25-Sep-08	5.59100	**5.60530**	0.2557
26-Sep-08	5.84399	**5.85893**	0.2557
27-Sep-08	5.30701	**5.32058**	0.2557
28-Sep-08	5.46600	**5.47998**	0.2557
29-Sep-08	6.32602	**6.34220**	0.2557
30-Sep-08	6.57996	**6.59678**	0.2557
01-Oct-08	6.01300	**6.02838**	0.2557
02-Oct-08	6.59204	**6.60890**	0.2557
03-Oct-08	7.29901	**7.31767**	0.2557
04-Oct-08	7.02899	**7.04696**	0.2557
05-Oct-08	6.64398	**6.66097**	0.2557
06-Oct-08	6.93103	**6.94875**	0.2557
07-Oct-08	4.92200	**4.93459**	0.2557
08-Oct-08	4.25299	**4.26386**	0.2557
09-Oct-08	4.17401	**4.18468**	0.2557
10-Oct-08	4.12199	**4.13253**	0.2557
11-Oct-08	4.00400	**4.01424**	0.2557
12-Oct-08	3.72500	**3.73452**	0.2557
13-Oct-08	4.17800	**4.18868**	0.2557
14-Oct-08	4.82000	**4.83232**	0.2557
15-Oct-08	5.60200	**5.61632**	0.2557
16-Oct-08	5.99800	**6.01334**	0.2557
17-Oct-08	6.49700	**6.51361**	0.2557
18-Oct-08	5.49100	**5.50504**	0.2557
19-Oct-08	5.76100	**5.77573**	0.2557
20-Oct-08	6.21900	**6.23490**	0.2557
21-Oct-08	7.19900	**7.21741**	0.2557
22-Oct-08	7.65800	**7.67758**	0.2557
23-Oct-08	5.66500	**5.67949**	0.2557
24-Oct-08	6.91400	**6.93168**	0.2557
25-Oct-08	7.12700	**7.14522**	0.2557
26-Oct-08	6.50700	**6.52364**	0.2557
27-Oct-08	4.50400	**4.51552**	0.2557
28-Oct-08	5.62300	**5.63738**	0.2557
29-Oct-08	5.72000	**5.73463**	0.2557
30-Oct-08	5.86600	**5.88100**	0.2557
31-Oct-08	5.09300	**5.10602**	0.2557
01-Nov-08	5.34801	**5.36168**	0.2557

02-Nov-08	5.11299	**5.12606**	0.2557
03-Nov-08	4.43900	**4.45035**	0.2557
04-Nov-08	5.48401	**5.49803**	0.2557
05-Nov-08	5.56599	**5.58022**	0.2557
06-Nov-08	5.59700	**5.61131**	0.2557
07-Nov-08	4.77800	**4.79022**	0.2557
08-Nov-08	4.52200	**4.53356**	0.2557
09-Nov-08	5.41701	**5.43086**	0.2557
10-Nov-08	6.76399	**6.78129**	0.2557
11-Nov-08	5.69901	**5.71358**	0.2557
12-Nov-08	5.05200	**5.06492**	0.2557
13-Nov-08	5.57399	**5.58824**	0.2557
14-Nov-08	4.24600	**4.25686**	0.2557
15-Nov-08	4.29201	**4.30298**	0.2557
16-Nov-08	4.86000	**4.87243**	0.2557
17-Nov-08	4.63899	**4.65085**	0.2557
18-Nov-08	4.25000	**4.26087**	0.2557
19-Nov-08	4.32001	**4.33106**	0.2557
20-Nov-08	4.50099	**4.51250**	0.2557
21-Nov-08	5.29800	**5.31155**	0.2557
22-Nov-08	5.59201	**5.60631**	0.2557
23-Nov-08	5.62999	**5.64439**	0.2557
24-Nov-08	6.01500	**6.03038**	0.2557
25-Nov-08	7.24001	**7.25852**	0.2557
26-Nov-08	5.68100	**5.69553**	0.2557
27-Nov-08	6.51901	**6.53568**	0.2557
28-Nov-08	6.12500	**6.14066**	0.2557
29-Nov-08	6.01797	**6.03336**	0.2557
30-Nov-08	6.60501	**6.62190**	0.2557
01-Dec-08	6.72299	**6.74018**	0.2557
02-Dec-08	5.83902	**5.85395**	0.2557
03-Dec-08	7.25998	**7.27854**	0.2557
04-Dec-08	6.63101	**6.64797**	0.2557
05-Dec-08	5.51599	**5.53009**	0.2557
06-Dec-08	5.47702	**5.49102**	0.2557
07-Dec-08	6.53500	**6.55171**	0.2557
08-Dec-08	7.43399	**7.45300**	0.2557
09-Dec-08	7.10599	**7.12416**	0.2557
10-Dec-08	8.34201	**8.36334**	0.2557
11-Dec-08	6.65500	**6.67202**	0.2557
12-Dec-08	8.25900	**8.28012**	0.2557
13-Dec-08	5.99899	**6.01433**	0.2557
14-Dec-08	5.88400	**5.89905**	0.2557
15-Dec-08	5.96500	**5.98025**	0.2557
16-Dec-08	6.99100	**7.00888**	0.2557
17-Dec-08	6.82101	**6.83845**	0.2557
18-Dec-08	5.11499	**5.12807**	0.2557
19-Dec-08	5.93802	**5.95320**	0.2557

20-Dec-08	4.35599	**4.36713**	0.2557
21-Dec-08	4.44501	**4.45638**	0.2557
22-Dec-08	4.13400	**4.14457**	0.2557
23-Dec-08	5.41599	**5.42984**	0.2557
24-Dec-08	4.87500	**4.88747**	0.2557
25-Dec-08	4.65100	**4.66289**	0.2557
26-Dec-08	5.00101	**5.01380**	0.2557
27-Dec-08	5.19400	**5.20728**	0.2557
28-Dec-08	5.48401	**5.49803**	0.2557
29-Dec-08	5.95798	**5.97321**	0.2557
30-Dec-08	7.53601	**7.55528**	0.2557
31-Dec-08	8.23700	**8.25806**	0.2557
01-Jan-09	6.64200	**6.65898**	0.2557
02-Jan-09	5.23300	**5.24638**	0.2557
03-Jan-09	6.02100	**6.03640**	0.2557
04-Jan-09	6.58701	**6.60385**	0.2557
05-Jan-09	7.88300	**7.90316**	0.2557
06-Jan-09	7.77502	**7.79490**	0.2557
07-Jan-09	7.52399	**7.54323**	0.2557
08-Jan-09	6.72601	**6.74321**	0.2557
09-Jan-09	8.16199	**8.18286**	0.2557
10-Jan-09	7.14197	**7.16023**	0.2557
11-Jan-09	7.20605	**7.22448**	0.2557
12-Jan-09	5.92499	**5.94014**	0.2557
13-Jan-09	6.32599	**6.34217**	0.2557
14-Jan-09	7.79199	**7.81191**	0.2557
15-Jan-09	6.63098	**6.64794**	0.2557
16-Jan-09	5.88202	**5.89706**	0.2557
17-Jan-09	4.90198	**4.91451**	0.2557
18-Jan-09	5.12201	**5.13511**	0.2557
19-Jan-09	6.78802	**6.80538**	0.2557
20-Jan-09	6.29199	**6.30808**	0.2557
21-Jan-09	6.17499	**6.19078**	0.2557
22-Jan-09	7.10400	**7.12216**	0.2557
23-Jan-09	6.32800	**6.34418**	0.2557
24-Jan-09	6.42102	**6.43744**	0.2557
25-Jan-09	5.43597	**5.44987**	0.2557
26-Jan-09	5.55103	**5.56522**	0.2557
27-Jan-09	9.90802	**9.93335**	0.2557
28-Jan-09	6.59296	**6.60982**	0.2557
29-Jan-09	6.22302	**6.23893**	0.2557
30-Jan-09	6.81000	**6.82741**	0.2557
31-Jan-09	5.55298	**5.56718**	0.2557
01-Feb-09	6.70801	**6.72516**	0.2557
02-Feb-09	7.67804	**7.69767**	0.2557
03-Feb-09	7.34094	**7.35971**	0.2557
04-Feb-09	7.23206	**7.25055**	0.2557
05-Feb-09	7.64398	**7.66353**	0.2557

06-Feb-09	7.43201	**7.45101**	0.2557
07-Feb-09	5.96600	**5.98126**	0.2557
08-Feb-09	6.52997	**6.54667**	0.2557
09-Feb-09	6.96704	**6.98485**	0.2557
10-Feb-09	6.18500	**6.20082**	0.2557
11-Feb-09	5.96399	**5.97924**	0.2557
12-Feb-09	6.45697	**6.47348**	0.2557
13-Feb-09	6.33405	**6.35025**	0.2557
14-Feb-09	5.50800	**5.52208**	0.2557
15-Feb-09	5.57001	**5.58425**	0.2557
16-Feb-09	5.07495	**5.08793**	0.2557
17-Feb-09	4.79803	**4.81030**	0.2557
18-Feb-09	4.69397	**4.70597**	0.2557
19-Feb-09	5.46899	**5.48297**	0.2557
20-Feb-09	4.92102	**4.93360**	0.2557
21-Feb-09	4.06598	**4.07638**	0.2557
22-Feb-09	4.12305	**4.13359**	0.2557
23-Feb-09	5.04199	**5.05488**	0.2557
24-Feb-09	4.37701	**4.38820**	0.2557
25-Feb-09	4.48999	**4.50147**	0.2557
26-Feb-09	5.33197	**5.34560**	0.2557
27-Feb-09	4.48303	**4.49449**	0.2557
28-Feb-09	4.92700	**4.93960**	0.2557
01-Mar-09	4.45795	**4.46935**	0.2557
02-Mar-09	5.28503	**5.29854**	0.2557
03-Mar-09	5.18201	**5.19526**	0.2557
04-Mar-09	5.53796	**5.55212**	0.2557
05-Mar-09	6.43005	**6.44649**	0.2557
06-Mar-09	5.61499	**5.62935**	0.2557
07-Mar-09	4.26996	**4.28088**	0.2557
08-Mar-09	5.21002	**5.22334**	0.2557
09-Mar-09	6.21399	**6.22988**	0.2557
10-Mar-09	5.52002	**5.53413**	0.2557
11-Mar-09	4.70300	**4.71503**	0.2557
12-Mar-09	3.95599	**3.96611**	0.2557
13-Mar-09	4.35498	**4.36612**	0.2557
14-Mar-09	3.83899	**3.84881**	0.2557
15-Mar-09	3.74603	**3.75561**	0.2557
16-Mar-09	3.93799	**3.94806**	0.2557
17-Mar-09	4.52002	**4.53158**	0.2557
18-Mar-09	4.98199	**4.99473**	0.2557
19-Mar-09	4.84698	**4.85937**	0.2557
20-Mar-09	3.85004	**3.85988**	0.2557
21-Mar-09	5.88397	**5.89902**	0.2557
22-Mar-09	6.62701	**6.64396**	0.2557
23-Mar-09	4.29999	**4.31099**	0.2557
24-Mar-09	4.46997	**4.48140**	0.2557
25-Mar-09	4.39203	**4.40326**	0.2557

26-Mar-09	4.19897	**4.20971**	0.2557
27-Mar-09	4.45001	**4.46139**	0.2557
28-Mar-09	4.31201	**4.32304**	0.2557
29-Mar-09	4.49298	**4.50447**	0.2557
30-Mar-09	4.83502	**4.84738**	0.2557
31-Mar-09	4.13000	**4.14056**	0.2557
01-Apr-09	3.79498	**3.80468**	0.2557
02-Apr-09	4.59503	**4.60678**	0.2557
03-Apr-09	4.50897	**4.52050**	0.2557
04-Apr-09	3.99200	**4.00221**	0.2557
05-Apr-09	3.99200	**4.00221**	0.2557
06-Apr-09	4.93100	**4.94361**	0.2557
07-Apr-09	4.49300	**4.50449**	0.2557
08-Apr-09	4.59000	**4.60174**	0.2557
09-Apr-09	4.06500	**4.07539**	0.2557
10-Apr-09	3.75800	**3.76761**	0.2557
11-Apr-09	3.91300	**3.92301**	0.2557
12-Apr-09	3.50800	**3.51697**	0.2557
13-Apr-09	3.65300	**3.66234**	0.2557
14-Apr-09	3.79300	**3.80270**	0.2557
15-Apr-09	4.74700	**4.75914**	0.2557
16-Apr-09	5.58600	**5.60028**	0.2557
17-Apr-09	5.13000	**5.14312**	0.2557
18-Apr-09	4.24900	**4.25986**	0.2557
19-Apr-09	4.13000	**4.14056**	0.2557
20-Apr-09	4.03200	**4.04231**	0.2557
21-Apr-09	3.55900	**3.56810**	0.2557
22-Apr-09	3.33100	**3.33952**	0.2557
23-Apr-09	4.22800	**4.23881**	0.2557
24-Apr-09	3.98800	**3.99820**	0.2557
25-Apr-09	3.99300	**4.00321**	0.2557
26-Apr-09	4.25200	**4.26287**	0.2557
27-Apr-09	7.80901	**7.82898**	0.2557
28-Apr-09	6.87099	**6.88856**	0.2557
29-Apr-09	6.21001	**6.22589**	0.2557
30-Apr-09	6.39100	**6.40734**	0.2557
01-May-09	4.84000	**4.85238**	0.2557
02-May-09	4.45700	**4.46840**	0.2557
03-May-09	4.97600	**4.98872**	0.2557
04-May-09	6.18800	**6.20382**	0.2557
05-May-09	5.69501	**5.70957**	0.2557
06-May-09	5.14400	**5.15715**	0.2557
07-May-09	5.31100	**5.31702**	0.1133