ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT ROSS WM

A Report for

National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA

PROJECT NO: NGR010 **REPORT NO: 2010/334** **DATE: 3 SEPTEMBER 2010**

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

NOTES

1 **This report may be published in full by the client unless it includes information supplied in confidence by TUV NEL Ltd or any third party. Such information, if included within the report, shall be identified as confidential by TUV NEL Ltd.**

2a **The prior written consent of TUV NEL Ltd shall be obtained by the client before publication by them of any extract from, or abridgement of, this report.**

2b **The prior written consent of TUV NEL Ltd shall be obtained by the client before publication:**

- **Where such publication is made in connection with any public enquiry, legal proceedings or arbitration.**
- **Where such publication is made in connection with any company prospectus or similar document.**
- **Where the client has notice that TUV NEL Ltd is seeking or intends to seek patent or like protection for any intellectual property produced in the course of rendering the services.**

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

Assessment of Error Due to Orifice Diameter Mis-Measurement at Ross WM

A Report for

National Grid
Brick Kiln Street
HINCKLEY
Leicestershire
LE10 0NA

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

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 Ross WM a correction factor of 1.002295 should be applied during the period of mis-measurement.

Over the period 25/10/2007 to 12/12/2008 inclusive the flow was 203.59861 mscm and the corrected flow should be 204.06476 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 Ross WM in the period of the error. The Joint Office Error Code is WM005.

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 (°C)	Orifice bore (mm)
OP4235	365-3	04/01/2005	114.6145	21	114.6127
OP60001	365-4	04/10/2006	114.61	21	114.6082
OP60185	365-3	08/12/2006	114.502	21	114.5002
OP80010	365-4	16/06/2008	114.613	20	114.613
OP80086	365-3	08/12/2008	114.623	20.3	114.6224
OP90039	365-4	13/10/2009	114.6085	20.2	114.6081

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.

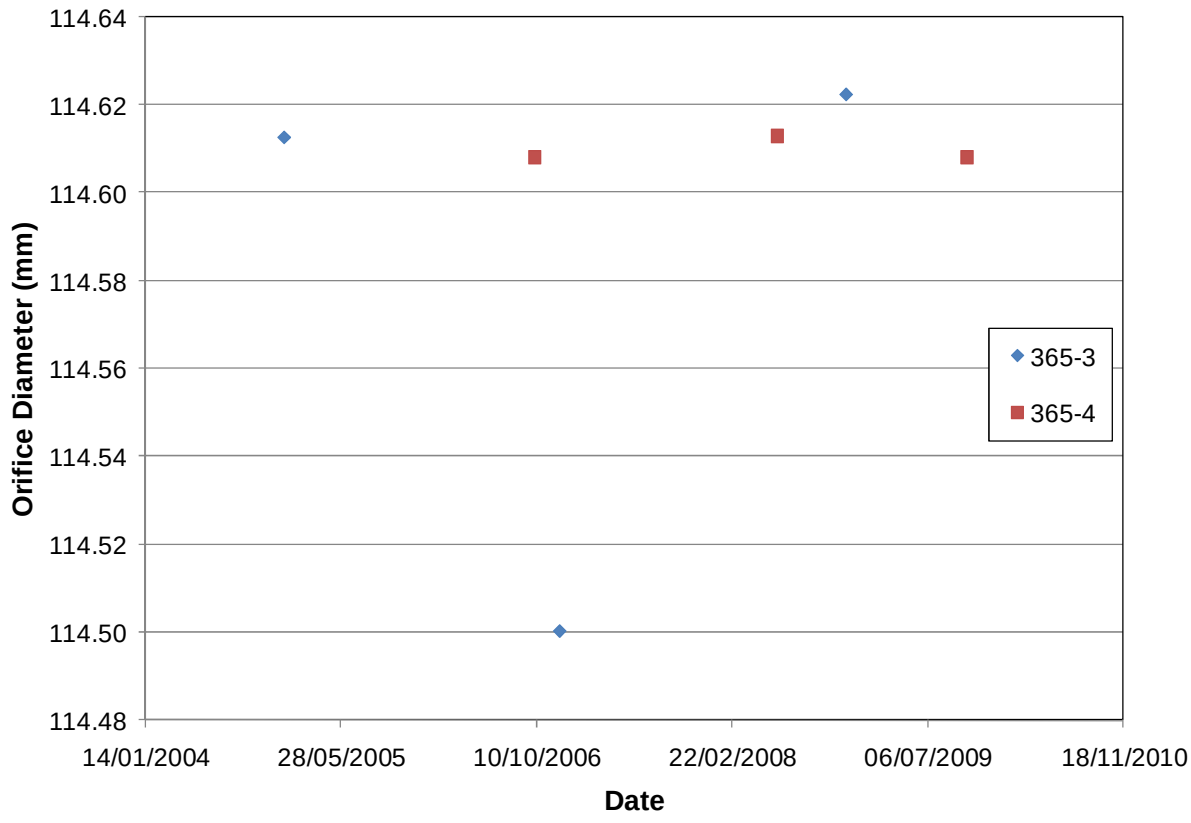

Figure 1 Orifice Diameters at 20 °C

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	omnM1017.cfg	omnM1025.cfg	omnN0312.cfg	omnN1212.cfg
	17/10/2007 23:01	25/10/2007 23:01	13/03/2008 00:01	13/12/2008 00:01
Orifice plate bore diameter (mm)	114.61	114.515	114.515	114.613
Expansion coefficient of the plate (/°C)	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	20	20
Meter tube diameter (mm)	203.454	203.454	203.454	203.454
Expansion coefficient of the meter tube (/°C)	0.000011	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20	20
Isentropic Exponent	1.3432	1.3432	1.3432	1.3449
Dynamic Viscosity (Pa.s)	0.0000119	0.0000119	0.0000119	0.000012
Orifice plate certificate number	OP60001	OP60185	OP60185	OP80010
Orifice plate serial number	365-4	365-3	365-3	365-4
Error in orifice diameter?	No	Yes	Yes	No

The orifice plate calibration temperature has been entered wrongly as 20°C in the configuration of 13/93/2008 00:01. The correction due to diameter mis-measurement alone (not wrong temperature entry) has been calculated.

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 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 60

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

Over the period from 25/10/2007 to 12/12/2008 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 203.454 mm, the isentropic exponent is 1.3432 and the dynamic viscosity 0.0000119 Pa s.

Table 3 The correction from 25/10/2007 to 12/12/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: Δp=10 mbar	114.50017	0.562782	0.999945	1129665	0.604510	
Corrected Δp=10 mbar	114.61756	0.563359	0.999945	1132258	0.604519	1.0022956
Original Δp=500 mbar	114.50017	0.562782	0.997238	7959940	0.604026	
Corrected Δp=500 mbar	114.61756	0.563359	0.997238	7978201	0.604035	1.0022941

So $q_{m,c}/q_{m,o}$ is 1.002295.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 25/10/2007 to 12/12/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 11:00; therefore 73.8% of the flow for 25/10/2007 has to be corrected and 35.2% for 12/12/2008 based on the flow before and after 11:00. Summing the data gives the figures in Table 4.

Table 4 The flow over the period 25/10/2007 to 12/12/2008 inclusive

Flow (mscm)	203.59861
Correction (mscm)	0.46615
Corrected flow (mscm)	204.06476
% Change	0.2290

5 CONCLUSIONS

A correction factor of 1.002295 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: ***OP4235***

TEMPERATURE: ***21 degsC***

MEASURED ORIFICE BORE: ***114.6145mm***

PLATE DETAILS

PLATE SERIAL.	365-3	PLATE O.D	214.231mm		
MANUFACTURER:		PIPE I.D:	mm	SITE:	ROSS
MATERIAL CERT.No.	M7121	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:- 15/10/05

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2		4	5	6		8
FLATNESS %	0.211	0.245	0.229	0.079	0.134	0.215	0.389	0.106
'E' mm	3.351	3.346	3.358	3.348	3.338	3.334	3.343	3.334
'e' mm								
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE: DEGS

CONCENTRICITY 0.066mm

SURFACE FINISH (Ra) 0.4 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.025mm TAPER: 0 degs

COMMENTS:

INSPECTED BY ..... G.WARDLE

VERIFIED BY.. ..... P.KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 04-10-06

REF NO: OP60001

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 114.61mm

PLATE DETAILS

PLATE SERIAL. 365-4 PLATE O.D 214.173mm

MANUFACTURER: PIPE I.D: mm SITE: ROSS

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 %	0.172	0.173	0.081	0.068	0.326	0.010	0.235	0.261
'E' mm	3.372	3.360	3.364	3.366	3.355	3.367	3.366	3.365
'e'								
EDGE SHARPNESS mm	0.0125	0.0125	SQUARE	SQUARE	SQUARE	SQUARE	0.0125	0.0125

BEVEL ANGLE:

CONCENTRICITY 0.009mm

SURFACE FINISH (Ra) 0.8 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.021mm TAPER: 0 degs

COMMENTS

INSPECTED BY.. P.KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: ***08-12-06***

REF NO: ***OP60185***

TEMPERATURE: ***21 degsC***

MEASURED ORIFICE BORE: ***114.502mm***

PLATE DETAILS

PLATE SERIAL.	365-3	PLATE O.D	214.029mm		
MANUFACTURER:		PIPE I.D:	mm	SITE:	ROSS
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				
FLATNESS %	0.242	0.067	0.253	0.039	0.171	0.019	0.427	0.045
'E' mm	3.397	3.398	3.334	3.329	3.394	3.395	3.310	3.309
'e' mm								
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125

BEVEL ANGLE: DEGS

CONCENTRICITY 0.035mm

SURFACE FINISH (Ra) 0.7 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION PASS

ROUNDNESS 0.112mm TAPER: 0 degs

COMMENTS

INSPECTED BY: P.KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 16-JUNE-2008

REF NO: OP80010

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 114.613mm

PLATE DETAILS

PLATE SERIAL.	365-4	PLATE O.D	214.161mm		
MANUFACTURER:		PIPE I.D:	203.454mm	SITE:	ROSS
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:-		2	3	4	5	6	7	8
FLATNESS %	0.016	0.139	0.142	0.006	0.075	0.026	0.146	0.200
'E' mm	3.365	3.361	3.365	3.367	3.370	3.367	3.369	3.363
'e' mm								
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.025	0.025	0.0125	0.0125

BEVEL ANGLE: DEGS

CONCENTRICITY 0.027mm

SURFACE FINISH (Ra) 0.7 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.025mm TAPER: 0 degs

COMMENTS: CLEAN PLATE

INSPECTED BY. M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 08-DEC-2008

REF NO: OP80086

TEMPERATURE: 20.3 degsC

MEASURED ORIFICE BORE: 114.623mm

PLATE DETAILS

PLATE SERIAL.	365-3	PLATE O.D	214.188mm		
MANUFACTURER:		PIPE I.D:	203.454mm	SITE:	ROSS
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 %	0.075	0.061	0.085	0.064	0.166	0.142	0.140	0.167
'E' mm	3.334	3.331	3.342	3.340	3.326	3.325	3.341	3.329
EDGE SHARPNESS mm	SQUARE	SQUARE	0.0125	0.0125	SQUARE	0.0125	SQUARE	0.0125

BEVEL ANGLE: DEGS

CONCENTRICITY 0.016mm

SURFACE FINISH (Ra) 0.18 microns

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.011mm TAPER 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE.

INSPECTED BY..... M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-OCT-2009

REF NO: OP90039

TEMPERATURE: 20.2 degsC

MEASURED ORIFICE BORE: 114.6085mm

PLATE DETAILS

PLATE SERIAL.	365-4	PLATE O.D	214.161mm		
MANUFACTURER:		PIPE I.D:	203.454mm	SITE:	ROSS
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		6		8
FLATNESS %	0.087	0.163	0.151	0.054	0.162	0.095	0.142	0.139
E' mm	3.371	3.365	3.357	3.359	3.372	3.371	3.362	3.367
'e'								
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.025	0.025	0.0125	

BEVEL ANGLE: DEGS

CONCENTRICITY 0.022mm

SURFACE FINISH (Ra) 0.5 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 ROSS WM DURING THE PERIOD OF THE MIS-MEASUREMENT

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
25-Oct-07	0.46510	**0.46589**	0.1694
26-Oct-07	0.40920	**0.41014**	0.2295
27-Oct-07	0.41330	**0.41425**	0.2295
28-Oct-07	0.41970	**0.42066**	0.2295
29-Oct-07	0.55440	**0.55567**	0.2295
30-Oct-07	0.51710	**0.51829**	0.2295
31-Oct-07	0.54920	**0.55046**	0.2295
01-Nov-07	0.43510	**0.43610**	0.2295
02-Nov-07	0.45130	**0.45234**	0.2295
03-Nov-07	0.65780	**0.65931**	0.2295
04-Nov-07	0.61670	**0.61812**	0.2295
05-Nov-07	0.50620	**0.50736**	0.2295
06-Nov-07	0.41340	**0.41435**	0.2295
07-Nov-07	0.60570	**0.60709**	0.2295
08-Nov-07	0.56520	**0.56650**	0.2295
09-Nov-07	0.67890	**0.68046**	0.2295
10-Nov-07	0.34580	**0.34659**	0.2295
11-Nov-07	0.48520	**0.48631**	0.2295
12-Nov-07	0.66720	**0.66873**	0.2295
13-Nov-07	0.62630	**0.62774**	0.2295
14-Nov-07	0.66980	**0.67134**	0.2295
15-Nov-07	0.67440	**0.67595**	0.2295
16-Nov-07	0.67900	**0.68056**	0.2295
17-Nov-07	0.58710	**0.58845**	0.2295
18-Nov-07	0.67130	**0.67284**	0.2295
19-Nov-07	0.43700	**0.43800**	0.2295
20-Nov-07	0.52370	**0.52490**	0.2295
21-Nov-07	0.58160	**0.58293**	0.2295
22-Nov-07	0.62000	**0.62142**	0.2295
23-Nov-07	0.62760	**0.62904**	0.2295
24-Nov-07	0.59350	**0.59486**	0.2295
25-Nov-07	0.55240	**0.55367**	0.2295
26-Nov-07	0.58430	**0.58564**	0.2295
27-Nov-07	0.50080	**0.50195**	0.2295
28-Nov-07	0.63610	**0.63756**	0.2295
29-Nov-07	0.56820	**0.56950**	0.2295
30-Nov-07	0.56130	**0.56259**	0.2295
01-Dec-07	0.50740	**0.50856**	0.2295
02-Dec-07	0.54350	**0.54475**	0.2295
03-Dec-07	0.59670	**0.59807**	0.2295
04-Dec-07	0.48520	**0.48631**	0.2295
05-Dec-07	0.46050	**0.46156**	0.2295
06-Dec-07	0.43020	**0.43119**	0.2295
07-Dec-07	0.46240	**0.46346**	0.2295
08-Dec-07	0.45450	**0.45554**	0.2295
09-Dec-07	0.51690	**0.51809**	0.2295
10-Dec-07	0.54220	**0.54344**	0.2295
11-Dec-07	0.68040	**0.68196**	0.2295
12-Dec-07	0.57670	**0.57802**	0.2295

13-Dec-07	0.52930	**0.53051**	0.2295
14-Dec-07	0.59370	**0.59506**	0.2295
15-Dec-07	0.59070	**0.59206**	0.2295
16-Dec-07	0.55810	**0.55938**	0.2295
17-Dec-07	0.63330	**0.63475**	0.2295
18-Dec-07	0.63290	**0.63435**	0.2295
19-Dec-07	0.60580	**0.60719**	0.2295
20-Dec-07	0.65540	**0.65690**	0.2295
21-Dec-07	0.55790	**0.55918**	0.2295
22-Dec-07	0.53430	**0.53553**	0.2295
23-Dec-07	0.67680	**0.67835**	0.2295
24-Dec-07	0.43220	**0.43319**	0.2295
25-Dec-07	0.61700	**0.61842**	0.2295
26-Dec-07	0.39970	**0.40062**	0.2295
27-Dec-07	0.39600	**0.39691**	0.2295
28-Dec-07	0.39010	**0.39100**	0.2295
29-Dec-07	0.46440	**0.46547**	0.2295
30-Dec-07	0.44410	**0.44512**	0.2295
31-Dec-07	0.37620	**0.37706**	0.2295
01-Jan-08	0.55860	**0.55988**	0.2295
02-Jan-08	0.71720	**0.71885**	0.2295
03-Jan-08	0.69380	**0.69539**	0.2295
04-Jan-08	0.57490	**0.57622**	0.2295
05-Jan-08	0.48560	**0.48671**	0.2295
06-Jan-08	0.53010	**0.53132**	0.2295
07-Jan-08	0.58080	**0.58213**	0.2295
08-Jan-08	0.60780	**0.60919**	0.2295
09-Jan-08	0.50090	**0.50205**	0.2295
10-Jan-08	0.49990	**0.50105**	0.2295
11-Jan-08	0.63850	**0.63997**	0.2295
12-Jan-08	0.57030	**0.57161**	0.2295
13-Jan-08	0.54310	**0.54435**	0.2295
14-Jan-08	0.44850	**0.44953**	0.2295
15-Jan-08	0.36300	**0.36383**	0.2295
16-Jan-08	0.53430	**0.53553**	0.2295
17-Jan-08	0.52930	**0.53051**	0.2295
18-Jan-08	0.45090	**0.45193**	0.2295
19-Jan-08	0.52810	**0.52931**	0.2295
20-Jan-08	0.43500	**0.43600**	0.2295
21-Jan-08	0.55610	**0.55738**	0.2295
22-Jan-08	0.53130	**0.53252**	0.2295
23-Jan-08	0.56160	**0.56289**	0.2295
24-Jan-08	0.58820	**0.58955**	0.2295
25-Jan-08	0.56300	**0.56429**	0.2295
26-Jan-08	0.44850	**0.44953**	0.2295
27-Jan-08	0.45150	**0.45254**	0.2295
28-Jan-08	0.74400	**0.74571**	0.2295
29-Jan-08	0.58420	**0.58554**	0.2295
30-Jan-08	0.49530	**0.49644**	0.2295
31-Jan-08	0.60461	**0.60600**	0.2295
01-Feb-08	0.56290	**0.56419**	0.2295
02-Feb-08	0.52310	**0.52430**	0.2295
03-Feb-08	0.68490	**0.68647**	0.2295
04-Feb-08	0.55800	**0.55928**	0.2295
05-Feb-08	0.60130	**0.60268**	0.2295
06-Feb-08	0.63790	**0.63936**	0.2295
07-Feb-08	0.44569	**0.44671**	0.2295
08-Feb-08	0.51640	**0.51759**	0.2295
09-Feb-08	0.54120	**0.54244**	0.2295
10-Feb-08	0.54500	**0.54625**	0.2295
11-Feb-08	0.57930	**0.58063**	0.2295

12-Feb-08	0.62510	**0.62653**	0.2295
13-Feb-08	0.67120	**0.67274**	0.2295
14-Feb-08	0.64730	**0.64879**	0.2295
15-Feb-08	0.50610	**0.50726**	0.2295
16-Feb-08	0.49990	**0.50105**	0.2295
17-Feb-08	0.53810	**0.53933**	0.2295
18-Feb-08	0.69650	**0.69810**	0.2295
19-Feb-08	0.63060	**0.63205**	0.2295
20-Feb-08	0.59290	**0.59426**	0.2295
21-Feb-08	0.61950	**0.62092**	0.2295
22-Feb-08	0.59410	**0.59546**	0.2295
23-Feb-08	0.59821	**0.59958**	0.2295
24-Feb-08	0.58490	**0.58624**	0.2295
25-Feb-08	0.56460	**0.56590**	0.2295
26-Feb-08	0.56670	**0.56800**	0.2295
27-Feb-08	0.62630	**0.62774**	0.2295
28-Feb-08	0.51720	**0.51839**	0.2295
29-Feb-08	0.49330	**0.49443**	0.2295
01-Mar-08	0.46510	**0.46617**	0.2295
02-Mar-08	0.53830	**0.53954**	0.2295
03-Mar-08	0.58060	**0.58193**	0.2295
04-Mar-08	0.54370	**0.54495**	0.2295
05-Mar-08	0.53370	**0.53492**	0.2295
06-Mar-08	0.49230	**0.49343**	0.2295
07-Mar-08	0.54180	**0.54304**	0.2295
08-Mar-08	0.49030	**0.49143**	0.2295
09-Mar-08	0.51640	**0.51759**	0.2295
10-Mar-08	0.47020	**0.47128**	0.2295
11-Mar-08	0.56130	**0.56259**	0.2295
12-Mar-08	0.61120	**0.61260**	0.2295
13-Mar-08	0.59580	**0.59717**	0.2295
14-Mar-08	0.48590	**0.48702**	0.2295
15-Mar-08	0.37360	**0.37446**	0.2295
16-Mar-08	0.57870	**0.58003**	0.2295
17-Mar-08	0.51930	**0.52049**	0.2295
18-Mar-08	0.65540	**0.65690**	0.2295
19-Mar-08	0.57620	**0.57752**	0.2295
20-Mar-08	0.50820	**0.50937**	0.2295
21-Mar-08	0.58000	**0.58133**	0.2295
22-Mar-08	0.61790	**0.61932**	0.2295
23-Mar-08	0.55010	**0.55136**	0.2295
24-Mar-08	0.57770	**0.57903**	0.2295
25-Mar-08	0.60930	**0.61070**	0.2295
26-Mar-08	0.54050	**0.54174**	0.2295
27-Mar-08	0.50330	**0.50446**	0.2295
28-Mar-08	0.53210	**0.53332**	0.2295
29-Mar-08	0.51749	**0.51868**	0.2295
30-Mar-08	0.49660	**0.49774**	0.2295
31-Mar-08	0.52750	**0.52871**	0.2295
01-Apr-08	0.52270	**0.52390**	0.2295
02-Apr-08	0.56080	**0.56209**	0.2295
03-Apr-08	0.53580	**0.53703**	0.2295
04-Apr-08	0.50160	**0.50275**	0.2295
05-Apr-08	0.60610	**0.60749**	0.2295
06-Apr-08	0.65470	**0.65620**	0.2295
07-Apr-08	0.68710	**0.68868**	0.2295
08-Apr-08	0.62030	**0.62172**	0.2295
09-Apr-08	0.60110	**0.60248**	0.2295
10-Apr-08	0.62660	**0.62804**	0.2295
11-Apr-08	0.52380	**0.52500**	0.2295
12-Apr-08	0.48180	**0.48291**	0.2295

13-Apr-08	0.50310	**0.50425**	0.2295
14-Apr-08	0.60160	**0.60298**	0.2295
15-Apr-08	0.54700	**0.54826**	0.2295
16-Apr-08	0.54160	**0.54284**	0.2295
17-Apr-08	0.45850	**0.45955**	0.2295
18-Apr-08	0.53910	**0.54034**	0.2295
19-Apr-08	0.43270	**0.43369**	0.2295
20-Apr-08	0.46090	**0.46196**	0.2295
21-Apr-08	0.53950	**0.54074**	0.2295
22-Apr-08	0.57700	**0.57832**	0.2295
23-Apr-08	0.49290	**0.49403**	0.2295
24-Apr-08	0.43260	**0.43359**	0.2295
25-Apr-08	0.46020	**0.46126**	0.2295
26-Apr-08	0.34710	**0.34790**	0.2295
27-Apr-08	0.40950	**0.41044**	0.2295
28-Apr-08	0.47870	**0.47980**	0.2295
29-Apr-08	0.53760	**0.53883**	0.2295
30-Apr-08	0.53920	**0.54044**	0.2295
01-May-08	0.46260	**0.46366**	0.2295
02-May-08	0.48720	**0.48832**	0.2295
03-May-08	0.43260	**0.43359**	0.2295
04-May-08	0.41060	**0.41154**	0.2295
05-May-08	0.39780	**0.39871**	0.2295
06-May-08	0.40660	**0.40753**	0.2295
07-May-08	0.38800	**0.38889**	0.2295
08-May-08	0.37910	**0.37997**	0.2295
09-May-08	0.41690	**0.41786**	0.2295
10-May-08	0.38020	**0.38107**	0.2295
11-May-08	0.38760	**0.38849**	0.2295
12-May-08	0.37600	**0.37686**	0.2295
13-May-08	0.40330	**0.40423**	0.2295
14-May-08	0.41400	**0.41495**	0.2295
15-May-08	0.49020	**0.49133**	0.2295
16-May-08	0.50460	**0.50576**	0.2295
17-May-08	0.48690	**0.48802**	0.2295
18-May-08	0.47630	**0.47739**	0.2295
19-May-08	0.48520	**0.48631**	0.2295
20-May-08	0.46140	**0.46246**	0.2295
21-May-08	0.42890	**0.42988**	0.2295
22-May-08	0.43630	**0.43730**	0.2295
23-May-08	0.41840	**0.41936**	0.2295
24-May-08	0.36730	**0.36814**	0.2295
25-May-08	0.37790	**0.37877**	0.2295
26-May-08	0.40800	**0.40894**	0.2295
27-May-08	0.39730	**0.39821**	0.2295
28-May-08	0.38660	**0.38749**	0.2295
29-May-08	0.37320	**0.37406**	0.2295
30-May-08	0.36500	**0.36584**	0.2295
31-May-08	0.38400	**0.38488**	0.2295
01-Jun-08	0.41090	**0.41184**	0.2295
02-Jun-08	0.41180	**0.41275**	0.2295
03-Jun-08	0.45220	**0.45324**	0.2295
04-Jun-08	0.41600	**0.41695**	0.2295
05-Jun-08	0.41620	**0.41716**	0.2295
06-Jun-08	0.40490	**0.40583**	0.2295
07-Jun-08	0.32600	**0.32675**	0.2295
08-Jun-08	0.33650	**0.33727**	0.2295
09-Jun-08	0.43870	**0.43971**	0.2295
10-Jun-08	0.52450	**0.52570**	0.2295
11-Jun-08	0.54550	**0.54675**	0.2295
12-Jun-08	0.54100	**0.54224**	0.2295

13-Jun-08	0.54070	**0.54194**	0.2295
14-Jun-08	0.48870	**0.48982**	0.2295
15-Jun-08	0.51220	**0.51338**	0.2295
16-Jun-08	0.52670	**0.52791**	0.2295
17-Jun-08	0.53130	**0.53252**	0.2295
18-Jun-08	0.42820	**0.42918**	0.2295
19-Jun-08	0.53200	**0.53322**	0.2295
20-Jun-08	0.51660	**0.51779**	0.2295
21-Jun-08	0.51770	**0.51889**	0.2295
22-Jun-08	0.52190	**0.52310**	0.2295
23-Jun-08	0.52930	**0.53051**	0.2295
24-Jun-08	0.52100	**0.52220**	0.2295
25-Jun-08	0.52610	**0.52731**	0.2295
26-Jun-08	0.54000	**0.54124**	0.2295
27-Jun-08	0.51230	**0.51348**	0.2295
28-Jun-08	0.45620	**0.45725**	0.2295
29-Jun-08	0.48920	**0.49032**	0.2295
30-Jun-08	0.50700	**0.50816**	0.2295
01-Jul-08	0.43460	**0.43560**	0.2295
02-Jul-08	0.45000	**0.45103**	0.2295
03-Jul-08	0.43630	**0.43730**	0.2295
04-Jul-08	0.50260	**0.50375**	0.2295
05-Jul-08	0.44030	**0.44131**	0.2295
06-Jul-08	0.44750	**0.44853**	0.2295
07-Jul-08	0.40650	**0.40743**	0.2295
08-Jul-08	0.36360	**0.36443**	0.2295
09-Jul-08	0.41980	**0.42076**	0.2295
10-Jul-08	0.41650	**0.41746**	0.2295
11-Jul-08	0.40810	**0.40904**	0.2295
12-Jul-08	0.40400	**0.40493**	0.2295
13-Jul-08	0.39620	**0.39711**	0.2295
14-Jul-08	0.38970	**0.39059**	0.2295
15-Jul-08	0.38640	**0.38729**	0.2295
16-Jul-08	0.34670	**0.34750**	0.2295
17-Jul-08	0.29140	**0.29207**	0.2295
18-Jul-08	0.27760	**0.27824**	0.2295
19-Jul-08	0.41230	**0.41325**	0.2295
20-Jul-08	0.44290	**0.44392**	0.2295
21-Jul-08	0.37050	**0.37135**	0.2295
22-Jul-08	0.24510	**0.24566**	0.2295
23-Jul-08	0.20860	**0.20908**	0.2295
24-Jul-08	0.20090	**0.20136**	0.2295
25-Jul-08	0.20420	**0.20467**	0.2295
26-Jul-08	0.27690	**0.27754**	0.2295
27-Jul-08	0.31320	**0.31392**	0.2295
28-Jul-08	0.34240	**0.34319**	0.2295
29-Jul-08	0.21870	**0.21920**	0.2295
30-Jul-08	0.21920	**0.21970**	0.2295
31-Jul-08	0.26020	**0.26080**	0.2295
01-Aug-08	0.29700	**0.29768**	0.2295
02-Aug-08	0.27320	**0.27383**	0.2295
03-Aug-08	0.29150	**0.29217**	0.2295
04-Aug-08	0.32020	**0.32093**	0.2295
05-Aug-08	0.27900	**0.27964**	0.2295
06-Aug-08	0.27350	**0.27413**	0.2295
07-Aug-08	0.33650	**0.33727**	0.2295
08-Aug-08	0.32520	**0.32595**	0.2295
09-Aug-08	0.30600	**0.30670**	0.2295
10-Aug-08	0.32030	**0.32104**	0.2295
11-Aug-08	0.37290	**0.37376**	0.2295
12-Aug-08	0.37780	**0.37867**	0.2295

13-Aug-08	0.39950	**0.40042**	0.2295
14-Aug-08	0.36630	**0.36714**	0.2295
15-Aug-08	0.37010	**0.37095**	0.2295
16-Aug-08	0.36120	**0.36203**	0.2295
17-Aug-08	0.37570	**0.37656**	0.2295
18-Aug-08	0.41620	**0.41716**	0.2295
19-Aug-08	0.32570	**0.32645**	0.2295
20-Aug-08	0.32130	**0.32204**	0.2295
21-Aug-08	0.35780	**0.35862**	0.2295
22-Aug-08	0.34230	**0.34309**	0.2295
23-Aug-08	0.29450	**0.29518**	0.2295
24-Aug-08	0.27390	**0.27453**	0.2295
25-Aug-08	0.29520	**0.29588**	0.2295
26-Aug-08	0.31160	**0.31232**	0.2295
27-Aug-08	0.27420	**0.27483**	0.2295
28-Aug-08	0.25720	**0.25779**	0.2295
29-Aug-08	0.30940	**0.31011**	0.2295
30-Aug-08	0.37530	**0.37616**	0.2295
31-Aug-08	0.43170	**0.43269**	0.2295
01-Sep-08	0.46060	**0.46166**	0.2295
02-Sep-08	0.46170	**0.46276**	0.2295
03-Sep-08	0.49610	**0.49724**	0.2295
04-Sep-08	0.45040	**0.45143**	0.2295
05-Sep-08	0.40600	**0.40693**	0.2295
06-Sep-08	0.41550	**0.41645**	0.2295
07-Sep-08	0.51960	**0.52079**	0.2295
08-Sep-08	0.52620	**0.52741**	0.2295
09-Sep-08	0.55920	**0.56048**	0.2295
10-Sep-08	0.47330	**0.47439**	0.2295
11-Sep-08	0.47800	**0.47910**	0.2295
12-Sep-08	0.47820	**0.47930**	0.2295
13-Sep-08	0.43440	**0.43540**	0.2295
14-Sep-08	0.47580	**0.47689**	0.2295
15-Sep-08	0.46190	**0.46296**	0.2295
16-Sep-08	0.45560	**0.45665**	0.2295
17-Sep-08	0.42320	**0.42417**	0.2295
18-Sep-08	0.39340	**0.39430**	0.2295
19-Sep-08	0.36560	**0.36644**	0.2295
20-Sep-08	0.32280	**0.32354**	0.2295
21-Sep-08	0.37110	**0.37195**	0.2295
22-Sep-08	0.43630	**0.43730**	0.2295
23-Sep-08	0.49480	**0.49594**	0.2295
24-Sep-08	0.46570	**0.46677**	0.2295
25-Sep-08	0.42980	**0.43079**	0.2295
26-Sep-08	0.41070	**0.41164**	0.2295
27-Sep-08	0.41450	**0.41545**	0.2295
28-Sep-08	0.47480	**0.47589**	0.2295
29-Sep-08	0.46830	**0.46937**	0.2295
30-Sep-08	0.47041	**0.47149**	0.2295
01-Oct-08	0.48660	**0.48772**	0.2295
02-Oct-08	0.53520	**0.53643**	0.2295
03-Oct-08	0.52610	**0.52731**	0.2295
04-Oct-08	0.43610	**0.43710**	0.2295
05-Oct-08	0.42609	**0.42707**	0.2295
06-Oct-08	0.40791	**0.40885**	0.2295
07-Oct-08	0.53750	**0.53873**	0.2295
08-Oct-08	0.41930	**0.42026**	0.2295
09-Oct-08	0.45070	**0.45173**	0.2295
10-Oct-08	0.43050	**0.43149**	0.2295
11-Oct-08	0.37720	**0.37807**	0.2295
12-Oct-08	0.36280	**0.36363**	0.2295

13-Oct-08	0.43610	**0.43710**	0.2295
14-Oct-08	0.49630	**0.49744**	0.2295
15-Oct-08	0.42800	**0.42898**	0.2295
16-Oct-08	0.44340	**0.44442**	0.2295
17-Oct-08	0.43120	**0.43219**	0.2295
18-Oct-08	0.45360	**0.45464**	0.2295
19-Oct-08	0.48710	**0.48822**	0.2295
20-Oct-08	0.50380	**0.50496**	0.2295
21-Oct-08	0.57450	**0.57582**	0.2295
22-Oct-08	0.62460	**0.62603**	0.2295
23-Oct-08	0.64580	**0.64728**	0.2295
24-Oct-08	0.56820	**0.56950**	0.2295
25-Oct-08	0.62730	**0.62874**	0.2295
26-Oct-08	0.64240	**0.64387**	0.2295
27-Oct-08	0.46350	**0.46456**	0.2295
28-Oct-08	0.44890	**0.44993**	0.2295
29-Oct-08	0.51420	**0.51538**	0.2295
30-Oct-08	0.54300	**0.54425**	0.2295
31-Oct-08	0.63600	**0.63746**	0.2295
01-Nov-08	0.67520	**0.67675**	0.2295
02-Nov-08	0.68050	**0.68206**	0.2295
03-Nov-08	0.68550	**0.68707**	0.2295
04-Nov-08	0.50420	**0.50536**	0.2295
05-Nov-08	0.47750	**0.47860**	0.2295
06-Nov-08	0.47410	**0.47519**	0.2295
07-Nov-08	0.61070	**0.61210**	0.2295
08-Nov-08	0.49300	**0.49413**	0.2295
09-Nov-08	0.51160	**0.51277**	0.2295
10-Nov-08	0.60320	**0.60458**	0.2295
11-Nov-08	0.67130	**0.67284**	0.2295
12-Nov-08	0.56080	**0.56209**	0.2295
13-Nov-08	0.56560	**0.56690**	0.2295
14-Nov-08	0.50780	**0.50897**	0.2295
15-Nov-08	0.45060	**0.45163**	0.2295
16-Nov-08	0.54190	**0.54314**	0.2295
17-Nov-08	0.52270	**0.52390**	0.2295
18-Nov-08	0.40520	**0.40613**	0.2295
19-Nov-08	0.50470	**0.50586**	0.2295
20-Nov-08	0.40680	**0.40773**	0.2295
21-Nov-08	0.48920	**0.49032**	0.2295
22-Nov-08	0.54900	**0.55026**	0.2295
23-Nov-08	0.55010	**0.55136**	0.2295
24-Nov-08	0.58600	**0.58734**	0.2295
25-Nov-08	0.66000	**0.66151**	0.2295
26-Nov-08	0.50640	**0.50756**	0.2295
27-Nov-08	0.38900	**0.38989**	0.2295
28-Nov-08	0.54150	**0.54274**	0.2295
29-Nov-08	0.69360	**0.69519**	0.2295
30-Nov-08	0.72140	**0.72306**	0.2295
01-Dec-08	0.69550	**0.69710**	0.2295
02-Dec-08	0.46780	**0.46887**	0.2295
03-Dec-08	0.60910	**0.61050**	0.2295
04-Dec-08	0.55570	**0.55698**	0.2295
05-Dec-08	0.51630	**0.51748**	0.2295
06-Dec-08	0.50300	**0.50415**	0.2295
07-Dec-08	0.44080	**0.44181**	0.2295
08-Dec-08	0.50860	**0.50977**	0.2295
09-Dec-08	0.58940	**0.59075**	0.2295
10-Dec-08	0.58060	**0.58193**	0.2295
11-Dec-08	0.60700	**0.60839**	0.2295
12-Dec-08	0.55730	**0.55775**	0.0809