



ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT WEST WINCH

A Report for

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

PROJECT NO: NGR010

REPORT NO: 2010/288

DATE: 18 AUGUST 2010



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

NOTES

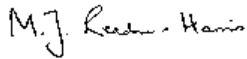
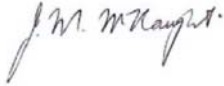
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Assessment of Error Due to Orifice Diameter Mis-Measurement at West Winch

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: 18 August 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 West Winch a correction factor of 1.002699 should be applied during the period of mis-measurement.

Over the period 22/03/2007 to 20/03/2008 inclusive the flow was 130.88808 mscm and the corrected flow should be 131.23986 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 West Winch in the period of the error. The Joint Office Error Code is EA006.

2 ORIFICE DIAMETERS

The calibrations of the orifice plates in question gave the measured diameters shown in Table 1. The diameters at 20 °C have been calculated.

**TABLE 1
ORIFICE DIAMETERS**

Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature	Value at 20 °C Orifice bore (mm)
OP4188	490-1	10/03/2005	95.879	21	95.8775
OP60015	490-2	13/02/2006	95.897	21	95.8955
OP70029	490-1	13/03/2007	95.771	21	95.7695
OP80004	490-2	19/02/2008	95.894	20	95.8940
OP80047	490-1	08/08/2008	95.881	20	95.8810
OP90056	490-2	18/12/2009	95.902	20.7	95.9009

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.

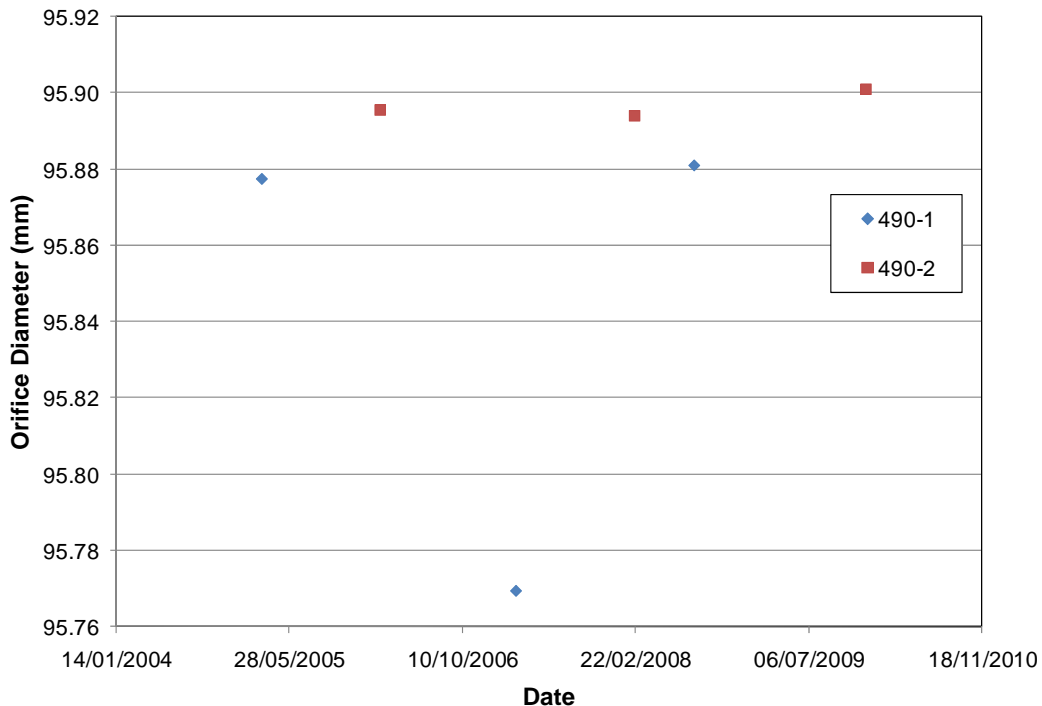


Figure 1 Orifice Diameters at 20 °C

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	omnM0316.cfg	omnM0322.cfg	omnN0128.cfg	omnN0320.cfg
	17/03/2007 00:01	23/03/2007 00:01	29/01/2008 00:01	21/03/2008 00:01
Orifice plate bore diameter (mm)	95.897	95.771	95.771	95.894
Expansion coefficient of the plate (1/°C)	0.000016	0.000016	0.000016	0.000016
Orifice plate calibration temperature	21	21	21	20
Meter tube diameter (mm)	153.8796	153.8796	153.8796	153.8796
Expansion coefficient of the meter tube (1/°C)	0.000011	0.000011	0.000011	0.000011
Meter tube calibration temperature	20	20	20	20
Isentropic Exponent	1.3511	1.3511	1.3507	1.3507
Dynamic Viscosity (Pa.s)	0.0000121	0.0000121	0.0000121	0.0000121
Orifice plate certificate number	OP60015	OP70029	OP70029	OP80004
Orifice plate serial number	490-2	490-1	490-1	490-2
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:

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

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 58 bar a; the change in $q_{m,c}/q_{m,o}$ due to changing the static pressure by 10 bar is around 0.00003%.

Over the period from 22/03/2007 to 28/01/2008 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 153.8796 mm, the isentropic exponent is 1.3511 and the dynamic viscosity 0.0000121 Pa s.

TABLE 3
THE CORRECTION FROM 22/03/2007 TO 28/01/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	95.76947	0.622366	0.999941	1041222	0.605425	
Corrected $\Delta p=10$ mbar	95.87923	0.62308	0.999941	1044033	0.605424	1.0026999
Original $\Delta p=500$ mbar	95.76947	0.622366	0.997049	7333232	0.604764	
Corrected $\Delta p=500$ mbar	95.87923	0.62308	0.997047	7353014	0.604763	1.0026975

So $q_{m,c}/q_{m,o}$ is 1.002699.

Over the period from 28/01/2008 to 20/03/2008 the correction can be calculated as in Table 4; throughout this calculation the meter tube diameter is 153.8796 mm, the isentropic exponent is 1.3507 and the dynamic viscosity 0.0000121 Pa s.

TABLE 4
THE CORRECTION FROM 28/01/2008 TO 20/03/2008

	d mm	β	ε	Re_D	C	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=10$ mbar	95.76947	0.622366	0.999941	1041222	0.605425	
Corrected $\Delta p=10$ mbar	95.87923	0.62308	0.999941	1044033	0.605424	1.0026999
Original $\Delta p=500$ mbar	95.76947	0.622366	0.997048	7333226	0.604764	
Corrected $\Delta p=500$ mbar	95.87923	0.62308	0.997047	7353007	0.604763	1.0026975

So $q_{m,c}/q_{m,o}$ is 1.002699.

4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 22/03/2007 to 20/03/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plates were changed at 11:30; therefore 70.5% of the flow for 22/03/2007 has to be corrected and 29.0% for 20/03/2008 based on the flow before and after 11:30. Summing the data gives the figures in Table 5.

TABLE 5**THE FLOW OVER THE PERIOD 22/03/2007 TO 20/03/2008 INCLUSIVE**

Flow (mscm)	130.88808
Correction (mscm)	0.35178
Corrected flow (mscm)	131.23986
% Change	0.2688

5 CONCLUSIONS

A correction factor of 1.002699 should be applied during the period of mis-measurement.

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

DATE: 10-03-05
REF NO: OP4188
TEMPERATURE: 21 degsC
MEASURED ORIFICE BORE: 95.879mm

PLATE DETAILS

PLATE SERIAL.	490-1	PLATE O.D	177.778mm		
MANUFACTURER:		PIPE I.D:	153.885mm	SITE:	WEST WINCH
MATERIAL CERT.No		DESIGN BORE:	95.887mm	FLOW:	960000 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	8
FLATNESS %	0.010	0.016	0.058	0.025	0.024	0.028	0.011	
Ø mm	9.510	9.514	9.510	9.506	9.500	9.470	9.471	
mm	2.578	2.571	2.543	2.549	2.553	2.559	2.572	2.583
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	36 DEGS							
CONCENTRICITY	0.008mm							
SURFACE FINISH (Ra)	0.8 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: 13-02-06

REF NO: OP60015

TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 95.897mm

PLATE DETAILS

PLATE SERIAL. 490-2 PLATE O.D 177.786mm
 MANUFACTURER: PIPE I.D: 153.885mm SITE: WEST WINCH
 MATERIAL CERT.NO. DESIGN BORE mm FLOW: .960000 M³/DAY

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 14/10/06

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:	1	2	3	4	5			
FLATNESS %	0.018	0.017	0.030	0.018	0.003	0.041	0.053	0.057
'E' mm	9.333	9.324	9.310	9.326	9.348	9.354	9.368	9.343
'e' mm	2.907	2.886	2.970	2.896	2.902	2.912	2.956	2.907
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	SQUARE	0.0125	SQUARE	0.0125	SQUARE
BEVEL ANGLE	37 DEGS							
CONCENTRICITY	0.019mm							
SURFACE FINISH (Ra)	1.1 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.007mm TAPER:

COMMENTS

INSPECTED BY:  P. KENNERSON

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 13-03-07
 REF NO: OP70029
 TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 95.771mm

PLATE DETAILS

PLATE SERIAL: 490-1 PLATE O.D: 177.661mm
 MANUFACTURER: PIPE I.D: mm SITE: WEST WINCH
 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)

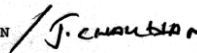
STATIONS:	1	2	3	4	5	6	7	8	
FLATNESS μ	0.009	0.027	0.032	0.023	0.001	0.007	0.032	0.032	
mm	9.559	9.487	9.484	9.555	9.544	9.467	9.472	9.544	
mm	2.592	2.551	2.544	2.686	2.605	2.571	2.562	2.610	
EDGE SHARPNESS mm	0.0125	0.0125	SQ	0.0125	SQ	0.0125	0.0125	0.0125	
BEVEL ANGLE	37 DEGS								
CONCENTRICITY	0.012mm								
SURFACE FINISH (Ra)	0.9 microns								
DOWNSTREAM FACE/EDGE VISUAL INSPECTION	PASS								
ROUNDNESS :	0.085mm	TAPER:	0 degs						

COMMENTS:

INSPECTED BY



P. KENNERSON



NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 19-FEB-2008
REF NO: OP80004
TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 95.894mm

PLATE DETAILS

PLATE SERIAL: 490-2 PLATE O.D 177.759mm
 MANUFACTURER: PIPE I.D: 153.8796mm SITE: WEST WINCH
 MATERIAL CERT.No. DESIGN BORE: mm FLOW: 0.960000 M³/DAY

TEST EQUIPMENT

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

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	6	8		
FLATNESS μ	0.128	0.035	0.020	0.146	0.193	0.184	0.039	0.120
mm	2.910	2.892	2.879	2.887	2.912	2.913	2.925	2.958
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	SQUARE	SQUARE	0.0125
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.262mm							
SURFACE FINISH (Ra)	0.5 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION PASS

ROUNDNESS 0.033mm TAPER: 01 degs

COMMENTS: LIGHT BROWN DEPOSIT OMLATE.

INSPECTED BY: *M Livingstone* M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 08-AUG-2008

REF NO: OP80047

TEMPERATURE: 20 degsC

MEASURED ORIFICE BORE: 95.881mm

PLATE DETAILS

PLATE SERIAL. 490-1 PLATE O.D 177.780mm
 MANUFACTURER: PIPE I.D: 153.8796mm SITE: WEST WINCH
 MATERIAL CERT.No. DESIGN BORE mm FLOW: M³/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	7	8	
FLATNESS %	0.008	0.006	0.005	0.032	0.008	0.060	0.012	0.031
'E' mm	9.498	9.496	9.491	9.481	9.472	9.487	9.486	9.489
mm	2.571	2.562	2.548	2.548	2.558	2.570	2.578	2.567
EDGE SHARPNESS mm	SQUARE	SQUARE	SQUARE	0.0125	0.0125	0.0125	SQUARE	SQUARE
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.043mm							
SURFACE FINISH (Ra)	0.54 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.008mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: LIGHT GREASE-OIL TO U-STREAM.

INSPECTED BY:  M Livingstone

NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 18-DEC-2009
 REF NO: OP90056
 TEMPERATURE: 20.7 degsC

MEASURED ORIFICE BORE: 95.902mm

PLATE DETAILS

PLATE SERIAL: 490-2 PLATE O.D: 177.778mm
 MANUFACTURER: PIPE I.D.: 153.8796mm SITE: WEST WINCH
 MATERIAL CERT.No. DESIGN BORE: mm FLOW: M³/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)

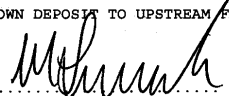
STATIONS	1	2	3	4	5	6	7	8
FLATNESS %	0.072	0.018	0.026	0.024	0.008	0.027	0.079	0.048
E mm	9.343	9.336	9.319	9.302	9.326	9.360	9.374	9.365
e mm	2.905	2.896	2.887	2.881	2.896	2.914	2.935	2.927
EDGE SHARPNESS mm	SQUARE	SQUARE	0.0125	SQUARE	0.0125	0.0125	SQUARE	SQUARE
BEVEL ANGLE:	37 DEGS							
CONCENTRICITY	0.028mm							
SURFACE FINISH (Ra)	0.4 microns							

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.009mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO) No

COMMENTS: BROWN DEPOSIT TO UPSTREAM FACE

INSPECTED BY:  M Livingstone

**APPENDIX B
CORRECTED DAILY VOLUME FLOWS**

TABLE B.1**FLOWS AT WEST WINCH DURING THE PERIOD OF THE MIS-MEASUREMENT**

	Original Values (total)	Corrected values (total)	% increase
Date	Volume (mscm)	Volume (mscm)	Volume (mscm)
22/03/2007	0.5616	0.56267	0.1903
23/03/2007	0.5090	0.51037	0.2699
24/03/2007	0.4925	0.49383	0.2699
25/03/2007	0.3906	0.39165	0.2699
26/03/2007	0.3902	0.39125	0.2699
27/03/2007	0.3496	0.35054	0.2699
28/03/2007	0.3562	0.35716	0.2699
29/03/2007	0.4119	0.41301	0.2699
30/03/2007	0.4017	0.40278	0.2699
31/03/2007	0.3588	0.35977	0.2699
01/04/2007	0.3514	0.35235	0.2699
02/04/2007	0.3898	0.39085	0.2699
03/04/2007	0.4734	0.47468	0.2699
04/04/2007	0.4518	0.45302	0.2699
05/04/2007	0.3277	0.32858	0.2699
06/04/2007	0.2884	0.28918	0.2699
07/04/2007	0.2635	0.26421	0.2699
08/04/2007	0.2342	0.23483	0.2699
09/04/2007	0.2542	0.25489	0.2699
10/04/2007	0.3237	0.32457	0.2699
11/04/2007	0.2716	0.27233	0.2699
12/04/2007	0.2983	0.29911	0.2699
13/04/2007	0.3396	0.34052	0.2699
14/04/2007	0.2591	0.25980	0.2699
15/04/2007	0.2221	0.22270	0.2699
16/04/2007	0.2601	0.26080	0.2699
17/04/2007	0.2919	0.29269	0.2699
18/04/2007	0.3031	0.30392	0.2699
19/04/2007	0.2707	0.27143	0.2699
20/04/2007	0.2870	0.28777	0.2699
21/04/2007	0.2252	0.22581	0.2699
22/04/2007	0.2241	0.22470	0.2699
23/04/2007	0.2535	0.25418	0.2699
24/04/2007	0.2264	0.22701	0.2699
25/04/2007	0.2291	0.22972	0.2699
26/04/2007	0.2748	0.27554	0.2699
27/04/2007	0.2779	0.27865	0.2699
28/04/2007	0.2274	0.22801	0.2699
29/04/2007	0.2224	0.22300	0.2699
30/04/2007	0.2492	0.24987	0.2699

01/05/2007	0.2346	0.23523	0.2699
02/05/2007	0.2583	0.25900	0.2699
03/05/2007	0.3191	0.31996	0.2699
04/05/2007	0.3231	0.32397	0.2699
05/05/2007	0.2697	0.27043	0.2699
06/05/2007	0.2403	0.24095	0.2699
07/05/2007	0.2454	0.24606	0.2699
08/05/2007	0.2838	0.28457	0.2699
09/05/2007	0.2590	0.25970	0.2699
10/05/2007	0.2698	0.27053	0.2699
11/05/2007	0.2703	0.27103	0.2699
12/05/2007	0.2374	0.23804	0.2699
13/05/2007	0.2660	0.26672	0.2699
14/05/2007	0.3258	0.32668	0.2699
15/05/2007	0.3099	0.31074	0.2699
16/05/2007	0.2918	0.29259	0.2699
17/05/2007	0.2490	0.24967	0.2699
18/05/2007	0.2165	0.21708	0.2699
19/05/2007	0.2137	0.21428	0.2699
20/05/2007	0.2150	0.21558	0.2699
21/05/2007	0.2631	0.26381	0.2699
22/05/2007	0.2127	0.21327	0.2699
23/05/2007	0.2066	0.20716	0.2699
24/05/2007	0.1957	0.19623	0.2699
25/05/2007	0.2092	0.20976	0.2699
26/05/2007	0.2208	0.22140	0.2699
27/05/2007	0.2956	0.29640	0.2699
28/05/2007	0.3827	0.38373	0.2699
29/05/2007	0.3976	0.39867	0.2699
30/05/2007	0.3363	0.33721	0.2699
31/05/2007	0.2316	0.23223	0.2699
01/06/2007	0.1958	0.19633	0.2699
02/06/2007	0.1676	0.16805	0.2699
03/06/2007	0.1566	0.15702	0.2699
04/06/2007	0.1825	0.18299	0.2699
05/06/2007	0.1989	0.19944	0.2699
06/06/2007	0.2601	0.26080	0.2699
07/06/2007	0.2505	0.25118	0.2699
08/06/2007	0.2462	0.24686	0.2699
09/06/2007	0.1660	0.16645	0.2699
10/06/2007	0.1889	0.18941	0.2699
11/06/2007	0.2047	0.20525	0.2699
12/06/2007	0.1862	0.18670	0.2699
13/06/2007	0.1859	0.18640	0.2699
14/06/2007	0.1840	0.18450	0.2699
15/06/2007	0.1745	0.17497	0.2699
16/06/2007	0.1580	0.15843	0.2699
17/06/2007	0.1593	0.15973	0.2699
18/06/2007	0.2148	0.21538	0.2699

19/06/2007	0.2136	0.21418	0.2699
20/06/2007	0.2017	0.20224	0.2699
21/06/2007	0.1792	0.17968	0.2699
22/06/2007	0.1642	0.16464	0.2699
23/06/2007	0.1355	0.13587	0.2699
24/06/2007	0.1681	0.16855	0.2699
25/06/2007	0.2002	0.20074	0.2699
26/06/2007	0.2382	0.23884	0.2699
27/06/2007	0.2366	0.23724	0.2699
28/06/2007	0.1923	0.19282	0.2699
29/06/2007	0.1856	0.18610	0.2699
30/06/2007	0.1545	0.15492	0.2699
01/07/2007	0.1472	0.14760	0.2699
02/07/2007	0.5968	0.59841	0.2699
03/07/2007	0.2122	0.21277	0.2699
04/07/2007	0.2067	0.20726	0.2699
05/07/2007	0.1960	0.19653	0.2699
06/07/2007	0.1821	0.18259	0.2699
07/07/2007	0.1461	0.14649	0.2699
08/07/2007	0.1492	0.14960	0.2699
09/07/2007	0.1750	0.17547	0.2699
10/07/2007	0.1754	0.17587	0.2699
11/07/2007	0.1820	0.18249	0.2699
12/07/2007	0.1662	0.16665	0.2699
13/07/2007	0.1553	0.15572	0.2699
14/07/2007	0.1382	0.13857	0.2699
15/07/2007	0.1496	0.15000	0.2699
16/07/2007	0.1737	0.17417	0.2699
17/07/2007	0.1955	0.19603	0.2699
18/07/2007	0.2023	0.20285	0.2699
19/07/2007	0.1933	0.19382	0.2699
20/07/2007	0.2127	0.21327	0.2699
21/07/2007	0.1745	0.17497	0.2699
22/07/2007	0.1702	0.17066	0.2699
23/07/2007	0.2141	0.21468	0.2699
24/07/2007	0.1988	0.19934	0.2699
25/07/2007	0.2098	0.21037	0.2699
26/07/2007	0.2131	0.21368	0.2699
27/07/2007	0.1898	0.19031	0.2699
28/07/2007	0.1606	0.16103	0.2699
29/07/2007	0.1794	0.17988	0.2699
30/07/2007	0.1902	0.19071	0.2699
31/07/2007	0.1787	0.17918	0.2699
01/08/2007	0.1744	0.17487	0.2699
02/08/2007	0.1895	0.19001	0.2699
03/08/2007	0.1653	0.16575	0.2699
04/08/2007	0.1402	0.14058	0.2699
05/08/2007	0.1463	0.14669	0.2699
06/08/2007	0.1979	0.19843	0.2699

07/08/2007	0.2097	0.21027	0.2699
08/08/2007	0.2129	0.21347	0.2699
09/08/2007	0.1885	0.18901	0.2699
10/08/2007	0.1711	0.17156	0.2699
11/08/2007	0.1457	0.14609	0.2699
12/08/2007	0.1470	0.14740	0.2699
13/08/2007	0.1741	0.17457	0.2699
14/08/2007	0.1805	0.18099	0.2699
15/08/2007	0.1523	0.15271	0.2699
16/08/2007	0.1726	0.17307	0.2699
17/08/2007	0.1909	0.19142	0.2699
18/08/2007	0.1674	0.16785	0.2699
19/08/2007	0.1692	0.16966	0.2699
20/08/2007	0.2140	0.21458	0.2699
21/08/2007	0.2118	0.21237	0.2699
22/08/2007	0.2366	0.23724	0.2699
23/08/2007	0.2353	0.23594	0.2699
24/08/2007	0.1976	0.19813	0.2699
25/08/2007	0.1478	0.14820	0.2699
26/08/2007	0.1396	0.13998	0.2699
27/08/2007	0.1606	0.16103	0.2699
28/08/2007	0.2007	0.20124	0.2699
29/08/2007	0.2031	0.20365	0.2699
30/08/2007	0.1893	0.18981	0.2699
31/08/2007	0.1925	0.19302	0.2699
01/09/2007	0.1712	0.17166	0.2699
02/09/2007	0.1851	0.18560	0.2699
03/09/2007	0.2138	0.21438	0.2699
04/09/2007	0.2002	0.20074	0.2699
05/09/2007	0.1871	0.18760	0.2699
06/09/2007	0.1796	0.18008	0.2699
07/09/2007	0.1828	0.18329	0.2699
08/09/2007	0.1660	0.16645	0.2699
09/09/2007	0.1742	0.17467	0.2699
10/09/2007	0.2022	0.20275	0.2699
11/09/2007	0.2111	0.21167	0.2699
12/09/2007	0.2159	0.21648	0.2699
13/09/2007	0.1919	0.19242	0.2699
14/09/2007	0.1930	0.19352	0.2699
15/09/2007	0.1720	0.17246	0.2699
16/09/2007	0.1794	0.17988	0.2699
17/09/2007	0.2239	0.22450	0.2699
18/09/2007	0.2766	0.27735	0.2699
19/09/2007	0.2709	0.27163	0.2699
20/09/2007	0.2203	0.22089	0.2699
21/09/2007	0.2140	0.21458	0.2699
22/09/2007	0.1708	0.17126	0.2699
23/09/2007	0.1838	0.18430	0.2699
24/09/2007	0.2278	0.22841	0.2699

25/09/2007	0.2517	0.25238	0.2699
26/09/2007	0.3143	0.31515	0.2699
27/09/2007	0.3035	0.30432	0.2699
28/09/2007	0.3176	0.31846	0.2699
29/09/2007	0.2451	0.24576	0.2699
30/09/2007	0.2640	0.26471	0.2699
01/10/2007	0.2960	0.29680	0.2699
02/10/2007	0.2859	0.28667	0.2699
03/10/2007	0.2695	0.27023	0.2699
04/10/2007	0.2499	0.25057	0.2699
05/10/2007	0.2585	0.25920	0.2699
06/10/2007	0.2230	0.22360	0.2699
07/10/2007	0.2379	0.23854	0.2699
08/10/2007	0.2849	0.28567	0.2699
09/10/2007	0.3247	0.32558	0.2699
10/10/2007	0.2689	0.26963	0.2699
11/10/2007	0.2967	0.29750	0.2699
12/10/2007	0.2303	0.23092	0.2699
13/10/2007	0.2037	0.20425	0.2699
14/10/2007	0.2433	0.24396	0.2699
15/10/2007	0.2927	0.29349	0.2699
16/10/2007	0.2872	0.28798	0.2699
17/10/2007	0.3248	0.32568	0.2699
18/10/2007	0.3692	0.37020	0.2699
19/10/2007	0.3681	0.36909	0.2699
20/10/2007	0.3360	0.33691	0.2699
21/10/2007	0.3448	0.34573	0.2699
22/10/2007	0.4215	0.42264	0.2699
23/10/2007	0.4260	0.42715	0.2699
24/10/2007	0.4131	0.41421	0.2699
25/10/2007	0.3921	0.39316	0.2699
26/10/2007	0.3844	0.38544	0.2699
27/10/2007	0.3429	0.34383	0.2699
28/10/2007	0.2995	0.30031	0.2699
29/10/2007	0.3599	0.36087	0.2699
30/10/2007	1.18958	1.19279	0.2699
31/10/2007	1.1274	1.13044	0.2699
01/11/2007	0.3463	0.34723	0.2699
02/11/2007	0.3189	0.31976	0.2699
03/11/2007	0.3098	0.31064	0.2699
04/11/2007	0.3735	0.37451	0.2699
05/11/2007	0.4840	0.48531	0.2699
06/11/2007	0.4624	0.46365	0.2699
07/11/2007	0.4089	0.41000	0.2699
08/11/2007	0.4424	0.44359	0.2699
09/11/2007	0.5042	0.50556	0.2699
10/11/2007	0.3933	0.39436	0.2699
11/11/2007	0.4333	0.43447	0.2699
12/11/2007	0.5358	0.53725	0.2699

TUV NEL

13/11/2007	0.5259	0.52732	0.2699
14/11/2007	0.5204	0.52180	0.2699
15/11/2007	0.5294	0.53083	0.2699
16/11/2007	0.5847	0.58628	0.2699
17/11/2007	0.5225	0.52391	0.2699
18/11/2007	0.5240	0.52541	0.2699
19/11/2007	0.5431	0.54457	0.2699
20/11/2007	0.5031	0.50446	0.2699
21/11/2007	0.4535	0.45472	0.2699
22/11/2007	0.4545	0.45573	0.2699
23/11/2007	0.5430	0.54447	0.2699
24/11/2007	0.5688	0.57034	0.2699
25/11/2007	0.5043	0.50566	0.2699
26/11/2007	0.5936	0.59520	0.2699
27/11/2007	0.5401	0.54156	0.2699
28/11/2007	0.49239	0.49372	0.2699
29/11/2007	0.4868	0.48811	0.2699
30/11/2007	0.4470	0.44821	0.2699
01/12/2007	0.4504	0.45162	0.2699
02/12/2007	0.4695	0.47077	0.2699
03/12/2007	0.54659	0.54807	0.2699
04/12/2007	0.5004	0.50175	0.2699
05/12/2007	0.4258	0.42695	0.2699
06/12/2007	0.42741	0.42856	0.2699
07/12/2007	0.4745	0.47578	0.2699
08/12/2007	0.5033	0.50466	0.2699
09/12/2007	0.4863	0.48761	0.2699
10/12/2007	0.5913	0.59290	0.2699
11/12/2007	0.6387	0.64042	0.2699
12/12/2007	0.6479	0.64965	0.2699
13/12/2007	0.6556	0.65737	0.2699
14/12/2007	0.6217	0.62338	0.2699
15/12/2007	0.5908	0.59239	0.2699
16/12/2007	0.6044	0.60603	0.2699
17/12/2007	0.6669	0.66870	0.2699
18/12/2007	0.6318	0.63351	0.2699
19/12/2007	0.6044	0.60603	0.2699
20/12/2007	0.5996	0.60122	0.2699
21/12/2007	0.5886	0.59019	0.2699
22/12/2007	0.53719	0.53864	0.2699
23/12/2007	0.5415	0.54296	0.2699
24/12/2007	0.4560	0.45723	0.2699
25/12/2007	0.3913	0.39236	0.2699
26/12/2007	0.4359	0.43708	0.2699
27/12/2007	0.4084	0.40950	0.2699
28/12/2007	0.41071	0.41182	0.2699
29/12/2007	0.4325	0.43367	0.2699
30/12/2007	0.4234	0.42454	0.2699
31/12/2007	0.4305	0.43166	0.2699

01/01/2008	0.41029	0.41140	0.2699
02/01/2008	0.5699	0.57144	0.2699
03/01/2008	0.6497	0.65145	0.2699
04/01/2008	0.5833	0.58487	0.2699
05/01/2008	0.5376	0.53905	0.2699
06/01/2008	0.5649	0.56642	0.2699
07/01/2008	0.6027	0.60433	0.2699
08/01/2008	0.5724	0.57394	0.2699
09/01/2008	0.5966	0.59821	0.2699
10/01/2008	0.5334	0.53484	0.2699
11/01/2008	0.5295	0.53093	0.2699
12/01/2008	0.5254	0.52682	0.2699
13/01/2008	0.4775	0.47879	0.2699
14/01/2008	0.5183	0.51970	0.2699
15/01/2008	0.4866	0.48791	0.2699
16/01/2008	0.5292	0.53063	0.2699
17/01/2008	0.5688	0.57034	0.2699
18/01/2008	0.5024	0.50376	0.2699
19/01/2008	0.4151	0.41622	0.2699
20/01/2008	0.3993	0.40038	0.2699
21/01/2008	0.4723	0.47357	0.2699
22/01/2008	0.5651	0.56663	0.2699
23/01/2008	0.4993	0.50065	0.2699
24/01/2008	0.5003	0.50165	0.2699
25/01/2008	0.5359	0.53735	0.2699
26/01/2008	0.4849	0.48621	0.2699
27/01/2008	0.4798	0.48109	0.2699
28/01/2008	0.5647	0.56622	0.2699
29/01/2008	0.5313	0.53273	0.2699
30/01/2008	0.5519	0.55339	0.2699
31/01/2008	0.60719	0.60883	0.2699
01/02/2008	0.62331	0.62499	0.2699
02/02/2008	0.6069	0.60854	0.2699
03/02/2008	0.5727	0.57425	0.2699
04/02/2008	0.5606	0.56211	0.2699
05/02/2008	0.5143	0.51569	0.2699
06/02/2008	1.56164	1.56585	0.2699
07/02/2008	1.54498	1.54915	0.2699
08/02/2008	0.4768	0.47809	0.2699
09/02/2008	0.4497	0.45091	0.2699
10/02/2008	0.4450	0.44620	0.2699
11/02/2008	0.5162	0.51759	0.2699
12/02/2008	0.5122	0.51358	0.2699
13/02/2008	0.5879	0.58949	0.2699
14/02/2008	0.5604	0.56191	0.2699
15/02/2008	0.5725	0.57405	0.2699
16/02/2008	0.5925	0.59410	0.2699
17/02/2008	0.5939	0.59550	0.2699
18/02/2008	0.6740	0.67582	0.2699

19/02/2008	0.7080	0.70991	0.2699
20/02/2008	0.6593	0.66108	0.2699
21/02/2008	0.5817	0.58327	0.2699
22/02/2008	0.4816	0.48290	0.2699
23/02/2008	0.4535	0.45472	0.2699
24/02/2008	0.4455	0.44670	0.2699
25/02/2008	0.5230	0.52441	0.2699
26/02/2008	0.4619	0.46315	0.2699
27/02/2008	0.4636	0.46485	0.2699
28/02/2008	0.4910	0.49233	0.2699
29/02/2008	0.5322	0.53364	0.2699
01/03/2008	0.4264	0.42755	0.2699
02/03/2008	0.4243	0.42545	0.2699
03/03/2008	0.5469	0.54838	0.2699
04/03/2008	0.6000	0.60162	0.2699
05/03/2008	0.5687	0.57023	0.2699
06/03/2008	0.4519	0.45312	0.2699
07/03/2008	0.4530	0.45422	0.2699
08/03/2008	0.4652	0.46646	0.2699
09/03/2008	0.4314	0.43256	0.2699
10/03/2008	0.5329	0.53434	0.2699
11/03/2008	0.4745	0.47578	0.2699
12/03/2008	0.4998	0.50115	0.2699
13/03/2008	0.4961	0.49744	0.2699
14/03/2008	0.4116	0.41271	0.2699
15/03/2008	0.3862	0.38724	0.2699
16/03/2008	0.4794	0.48069	0.2699
17/03/2008	0.5650	0.56652	0.2699
18/03/2008	0.5831	0.58467	0.2699
19/03/2008	0.5576	0.55910	0.2699
20/03/2008	0.5429	0.54333	0.0784