Key comparison CCM.FF-K2: liquid hydrocarbon flow

x_i : measurement result reported by laboratory i : Strouhal number at a constant Reynolds number Re = 10^{+5}
$U_{\text{Lab } i}$: expanded uncertainty of x_i

Measurements are taken with two meters, designated as "Kral meter" and "Turbine meter", and in two different configurations (Configuration 1: a flow conditioner is placed upstream of the turbine meter; Configuration 2: the flow conditioner is removed), as explained in Section 2.2 on page 7 of the Final Report.

Kral meter
Strouhal number at a constant Reynolds number Re = 10^{+5}

Lab i	x_i	$U_{\text{Lab } i}$ / %	x_i	$U_{\text{Lab } i}$ / %	Date of measurement
	Configuration 1		Configuration 2		
CMS/ITRI	7.9483	0.045	7.9482	0.045	March 2006
NMIJ	7.9485	0.03	7.9484	0.03	April 2006
NEL	7.9505	0.025	7.9516	0.025	October 2006
NMi-VSL	7.9523	0.04	7.9516	0.04	February 2007
FORCE	7.9511	0.035	7.9480	0.035	February 2007
SP	7.9502	0.028	7.9491	0.028	March 2007

Turbine meter
Strouhal number at a constant Reynolds number Re = 10^{+5}

Lab i	x_i	$U_{\text{Lab } i}$ / %	x_i	$U_{\text{Lab } i}$ / %	Date of measurement
	Configuration 1		Configuration 2		
CMS/ITRI	7.1870	0.045	7.1723	0.045	March 2006
NMIJ	7.1857	0.03	-	-	April 2006
NEL	7.1907	0.025	7.1719	0.025	October 2006
NMi-VSL	7.1895	0.04	-	-	February 2007
FORCE	7.1863	0.035	-	-	February 2007
SP	7.1880	0.028	7.1698	0.028	March 2007

Key comparison CCM.FF-K2: liquid hydrocarbon flow

Kral and Turbine meters
Strouhal number at a constant Reynolds number Re = 10^{+5}
Configuration 1: a flow conditioner is placed upstream of the turbine meter, Configuration 2: the flow conditioner is removed (as explained in Section 2.2 on page 7 of the Final Report)

For each flow meter and each configuration, the key comparison reference value, x_R, is calculated as the weighted mean of the participants' results, as explained in Section 5.4 on page 17 of the Final Report. Its expanded uncertainty is U_R.

Kral meter		Kral meter		Turbine meter		Turbine meter	
Configuration 1		Configuration 2		Configuration 1		Configuration 2	
x_R	U_R / %	x_R	U_R / %	x_R	U_R / %	x_R	U_R / %
7.9502	0.015	7.9496	0.015	7.1878	0.019	7.1715	0.030

The degree of equivalence of laboratory i with respect to the key comparison reference value is given by a pair of terms, both expressed in relative terms: $D_i = (x_i - x_R)/x_R$ and its expanded uncertainty $U_i = (U_{Lab\,i}^2 - U_R^2)^{1/2}$.

The degree of equivalence between two laboratories i and j is given by a pair of terms, both expressed in relative terms : $D_{ij} = (D_i - D_j)$ and associated expanded uncertainty $U_{ij} = (U_{Lab\,i}^2 + U_{Lab\,j}^2)^{1/2}$.
Pair-wise degrees of equivalence are not computed for the Turbine meter in Configuration 2.

Key comparison CCM.FF-K2: liquid hydrocarbon flow

Kral meter
Strouhal number at a constant Reynolds number Re = 10^{+5}
Configuration 1

Lab *j* ⇨

Lab *i* ⇩

	D_i / %	U_i / %	CMS/ITRI		NMIJ		NEL		NMi-VSL		FORCE		SP	
			D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %
CMS/ITRI	**-0.023**	0.044			**-0.002**	0.058	**-0.027**	0.055	**-0.049**	0.061	**-0.034**	0.058	**-0.023**	0.058
NMIJ	**-0.022**	0.032	**0.002**	0.058			**-0.025**	0.046	**-0.047**	0.054	**-0.032**	0.050	**-0.021**	0.050
NEL	**0.004**	0.026	**0.027**	0.055	**0.025**	0.046			**-0.022**	0.050	**-0.007**	0.046	**0.004**	0.046
NMi-VSL	**0.026**	0.038	**0.049**	0.061	**0.047**	0.054	**0.022**	0.050			**0.015**	0.054	**0.026**	0.053
FORCE	**0.011**	0.032	**0.034**	0.058	**0.032**	0.050	**0.007**	0.046	**-0.015**	0.054			**0.011**	0.049
SP	**-0.001**	0.032	**0.023**	0.058	**0.021**	0.050	**-0.004**	0.046	**-0.026**	0.053	**-0.011**	0.049		

Kral meter
Strouhal number at a constant Reynolds number Re = 10^{+5}
Configuration 2

Lab *j* ⇨

Lab *i* ⇩

	D_i / %	U_i / %	CMS/ITRI		NMIJ		NEL		NMi-VSL		FORCE		SP	
			D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %
CMS/ITRI	**-0.018**	0.044			**-0.002**	0.058	**-0.043**	0.055	**-0.042**	0.061	**0.002**	0.058	**-0.011**	0.058
NMIJ	**-0.016**	0.032	**0.002**	0.058			**-0.041**	0.046	**-0.041**	0.054	**0.004**	0.050	**-0.009**	0.050
NEL	**0.025**	0.026	**0.043**	0.055	**0.041**	0.046			**0.000**	0.050	**0.045**	0.046	**0.032**	0.046
NMi-VSL	**0.025**	0.038	**0.042**	0.061	**0.041**	0.054	**0.000**	0.050			**0.045**	0.054	**0.031**	0.054
FORCE	**-0.020**	0.032	**-0.002**	0.058	**-0.004**	0.050	**-0.045**	0.046	**-0.045**	0.054			**-0.013**	0.050
SP	**-0.007**	0.032	**0.011**	0.058	**0.009**	0.050	**-0.032**	0.046	**-0.031**	0.054	**0.013**	0.050		

Key comparison CCM.FF-K2: liquid hydrocarbon flow

Turbine meter
Strouhal number at a constant Reynolds number Re = 10^{+5}
Configuration 1

Lab *j* ⇨

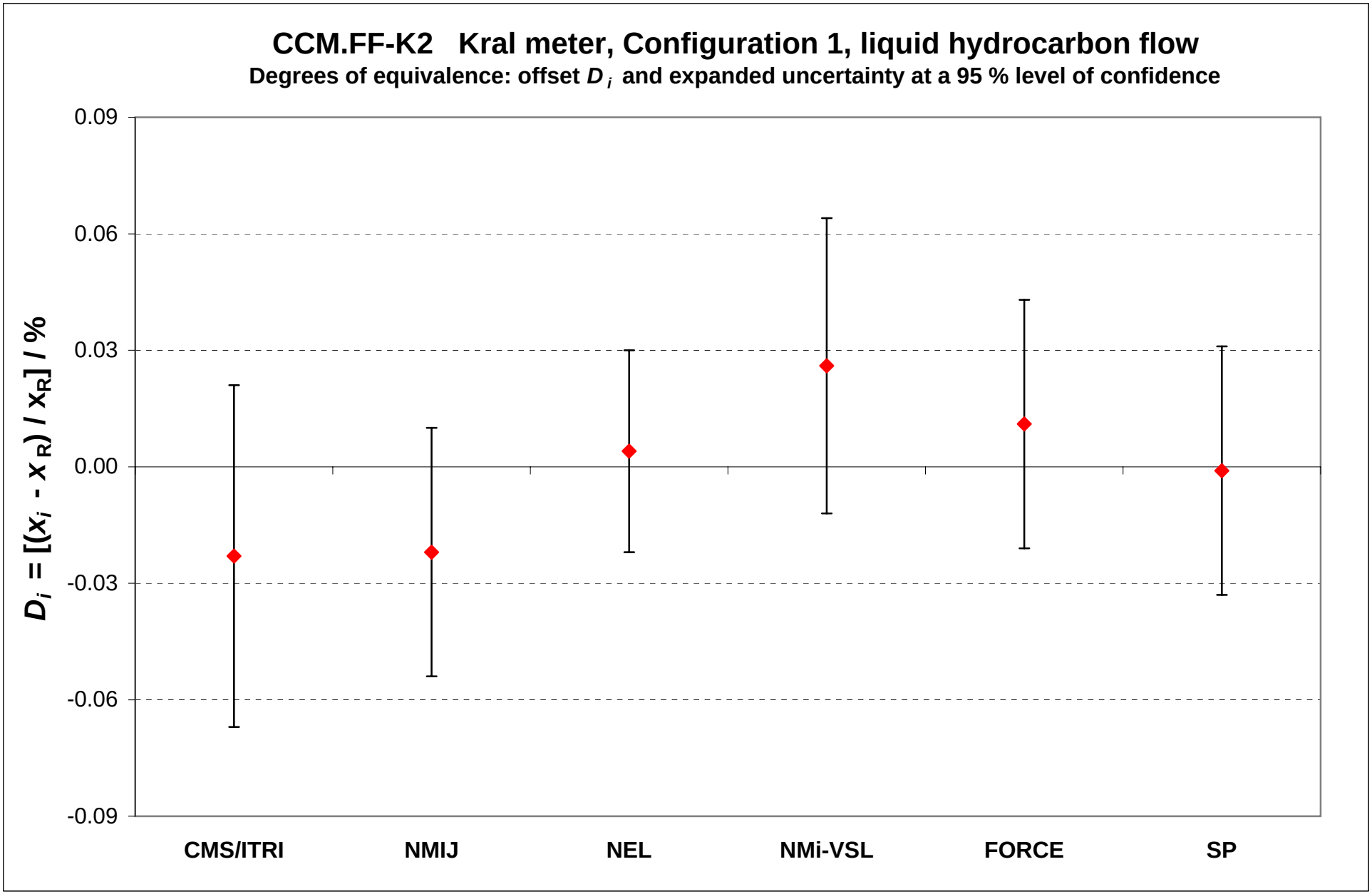
Lab *i* ⇩

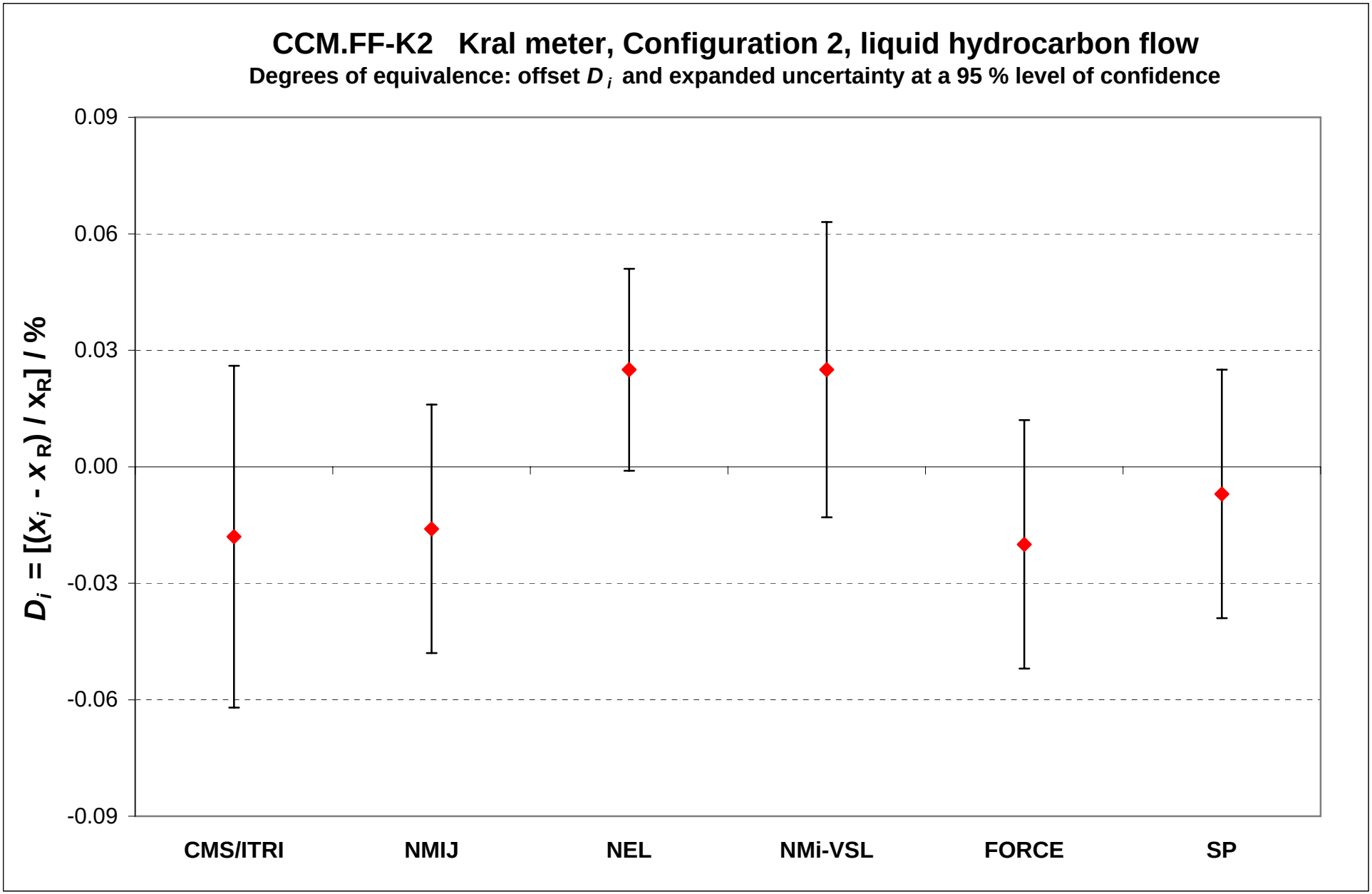
	D_i / %	U_i / %	CMS/ITRI		NMIJ		NEL		NMi-VSL		FORCE		SP	
			D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %	D_{ij} / %	U_{ij} / %
CMS/ITRI	**-0.012**	0.047			**0.018**	0.075	**-0.052**	0.069	**-0.036**	0.067	**0.009**	0.062	**-0.015**	0.077
NMIJ	**-0.030**	0.052	**-0.018**	0.075			**-0.070**	0.072	**-0.054**	0.070	**-0.008**	0.066	**-0.032**	0.080
NEL	**0.040**	0.043	**0.052**	0.069	**0.070**	0.072			**0.016**	0.064	**0.062**	0.058	**0.038**	0.074
NMi-VSL	**0.024**	0.039	**0.036**	0.067	**0.054**	0.070	**-0.016**	0.064			**0.045**	0.055	**0.021**	0.072
FORCE	**-0.022**	0.030	**-0.009**	0.062	**0.008**	0.066	**-0.062**	0.058	**-0.045**	0.055			**-0.024**	0.067
SP	**0.003**	0.054	**0.015**	0.077	**0.032**	0.080	**-0.038**	0.074	**-0.021**	0.072	**0.024**	0.067		

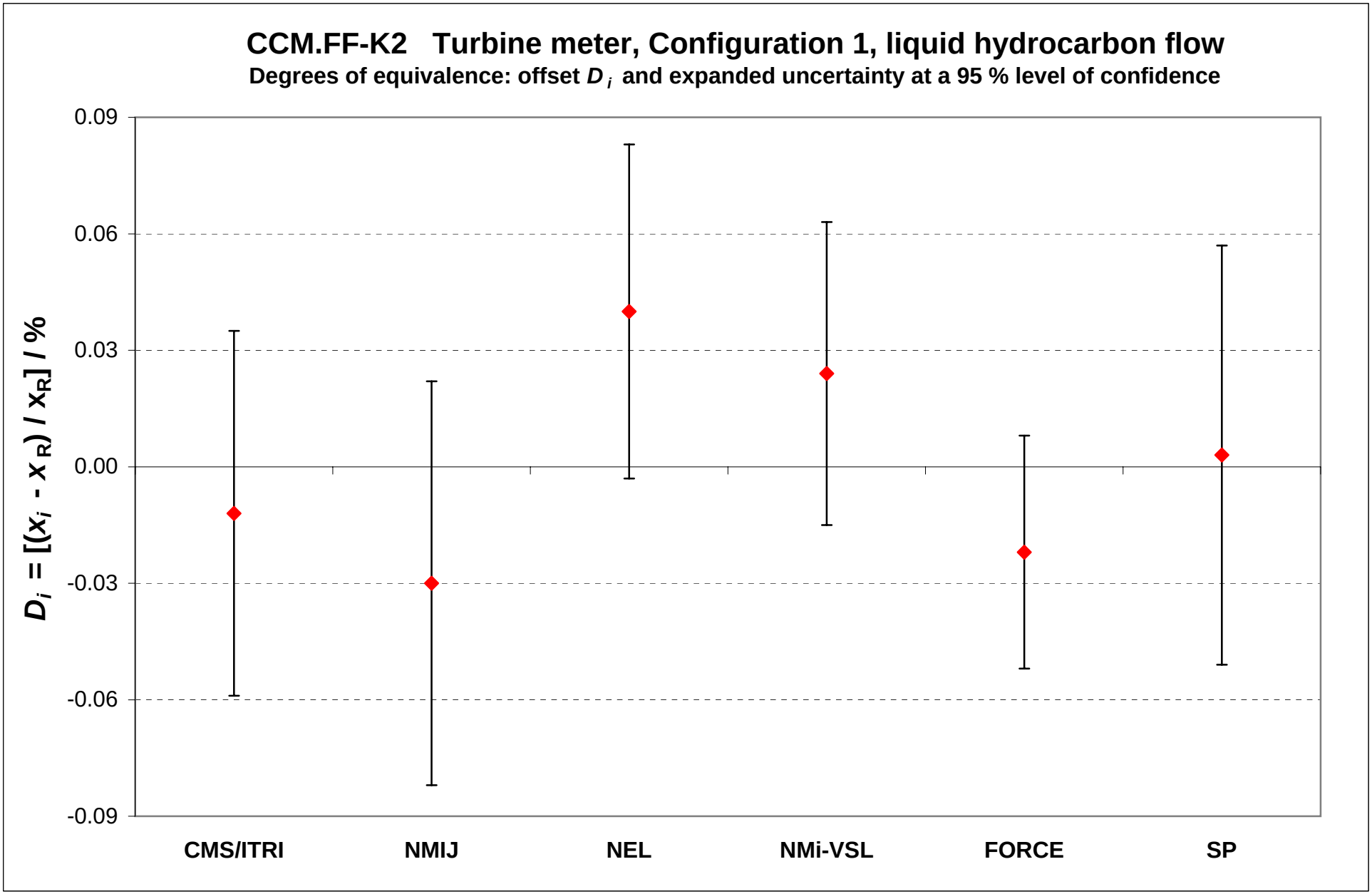
Turbine meter
Strouhal number at a constant Reynolds number Re = 10^{+5}
Configuration 2

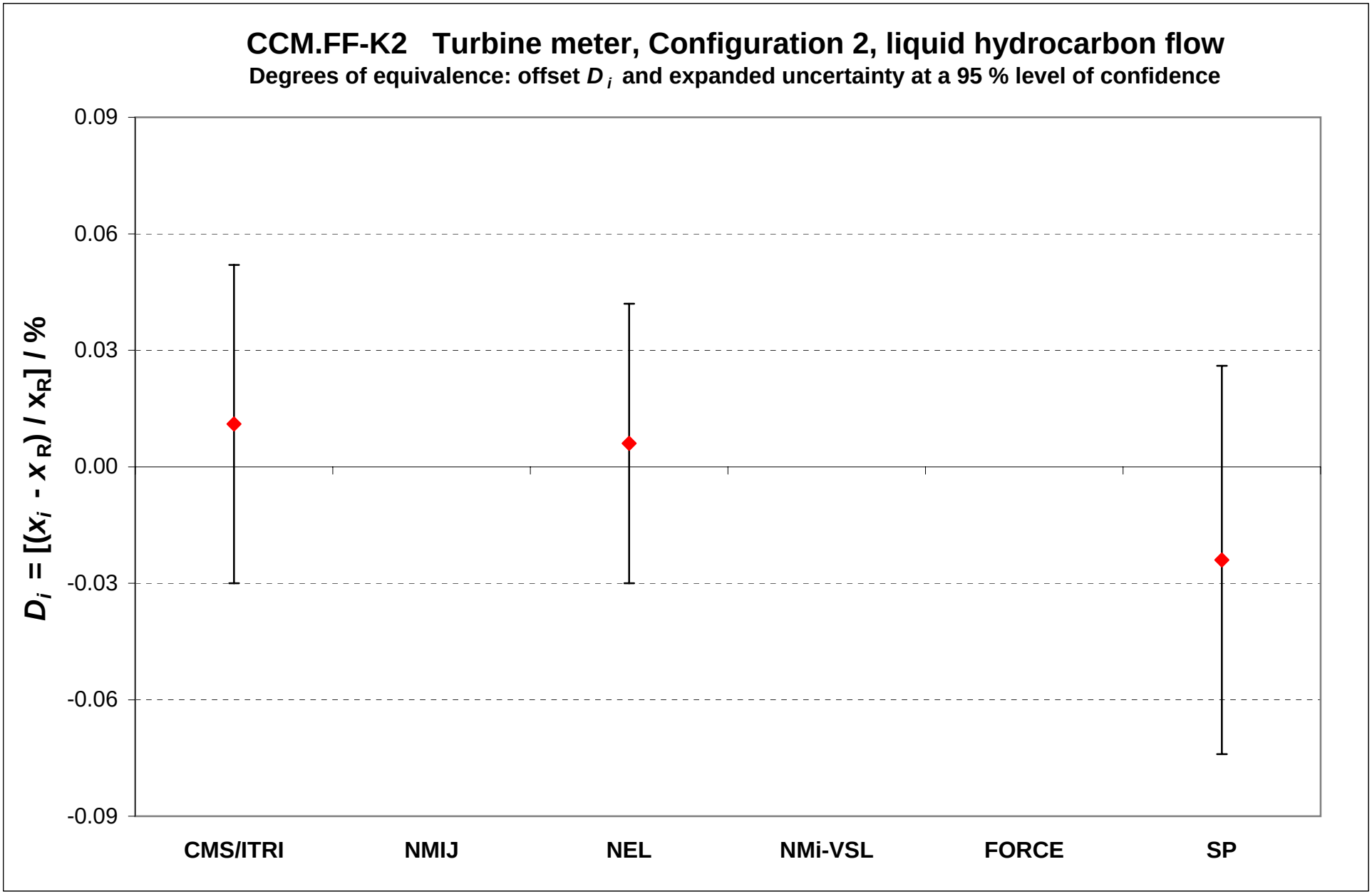
Lab *i* ⇩

	D_i / %	U_i / %
CMS/ITRI	**0.011**	0.041
NMIJ	**-**	-
NEL	**0.006**	0.036
NMi-VSL	**-**	-
FORCE	**-**	-
SP	**-0.024**	0.050


CCM.FF-K2 Kral meter, Configuration 1, liquid hydrocarbon flow
Degrees of equivalence: offset D_i and expanded uncertainty at a 95 % level of confidence
$D_i = [(x_i - x_R) / x_R] / \%$
0.09
0.06
0.03
0.00
-0.03
-0.06
-0.09
CMS/ITRI
NMIJ
NEL
NMi-VSL
FORCE
SP


CCM.FF-K2 Kral meter, Configuration 2, liquid hydrocarbon flow
Degrees of equivalence: offset D_i and expanded uncertainty at a 95 % level of confidence
$D_i = [(x_i - x_R) / x_R] / \%$
0.09
0.06
0.03
0.00
-0.03
-0.06
-0.09
CMS/ITRI
NMIJ
NEL
NMi-VSL
FORCE
SP


CCM.FF-K2 Turbine meter, Configuration 1, liquid hydrocarbon flow
Degrees of equivalence: offset D_i and expanded uncertainty at a 95 % level of confidence
$D_i = [(x_i - x_R) / x_R] / \%$
0.09
0.06
0.03
0.00
-0.03
-0.06
-0.09
CMS/ITRI
NMIJ
NEL
NMi-VSL
FORCE
SP


CCM.FF-K2 Turbine meter, Configuration 2, liquid hydrocarbon flow
Degrees of equivalence: offset D_i and expanded uncertainty at a 95 % level of confidence
$D_i = [(x_i - x_R) / x_R] / \%$
0.09
0.06
0.03
0.00
-0.03
-0.06
-0.09
CMS/ITRI
NMIJ
NEL
NMi-VSL
FORCE
SP