

NFOGMs verktøy for usikkerhetsberegninger

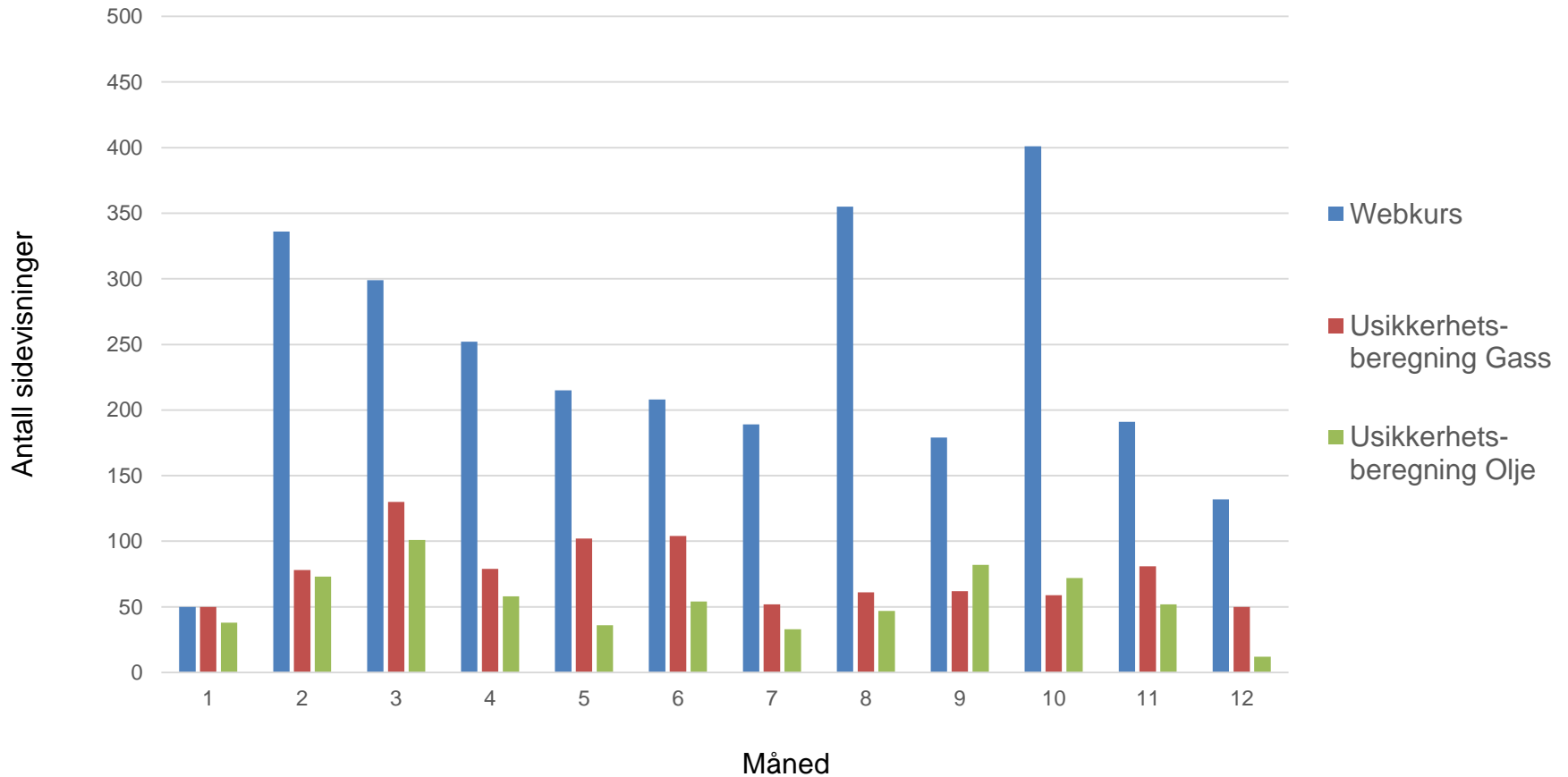
Oppdateringer 2017/2018

www.nfogm.no

Morten Marstein

Populært?

Brukerlogg NFOGM.no
2017



Hva er nytt?

GASS



- Gasskromatograf testkrav i.h.t. NORSOK I-106

OLJE



- Turbin-målestasjon
- Coriolis-målestasjon
- (Tidligere kun ultralyd-målestasjon)

Gass - GC og NOROK I-106

Fiscal Gas Metering Station Uncertainty

metering station conditions gas analysis flow meas resu



Overall Input Level

Select standard for overall uncertainty:

Component		Concentration mol%		Relative Unc. %
Methane	C1	86.29		0.84
Ethane	C2	6.01	0.0967	1.61
Propane	C3	3	0.0659	2.2
iso-Butane	iC4	1.1	0.05	4.55
n-Butane	nC4	0.9	0.05	5.56

Note: A red circle highlights the dropdown menu for 'Select standard for overall uncertainty' and the 'NORSOK I106' option in the table.

Olje – Valgmuligheter for måleteknologi

Valg av strømningsmåler

Fiscal Oil Metering Station Uncertainty
metering station

Configuration of the metering station

The screenshot shows the configuration interface for a flow meter. At the top, there are fields for 'Station Name' (26.01.2018) and 'Description'. Below this, the 'Flow Meter' section is active. The 'Flow Meter type:' dropdown menu is open, showing options: Turbine (selected), Ultrasonic, and Coriolis. The 'Type of device' dropdown is set to 'Ultrasonic'. The 'Temperature' and 'Pressure' dropdowns are both set to 'Single'. A schematic diagram below shows a 'Turbine Flow Meter' connected to a line with temperature (T_m) and pressure (P_m) sensors. A secondary line below has density (D), temperature (T_d), and pressure (P_d) sensors.

Valg av master/normal

ncertainty Tool

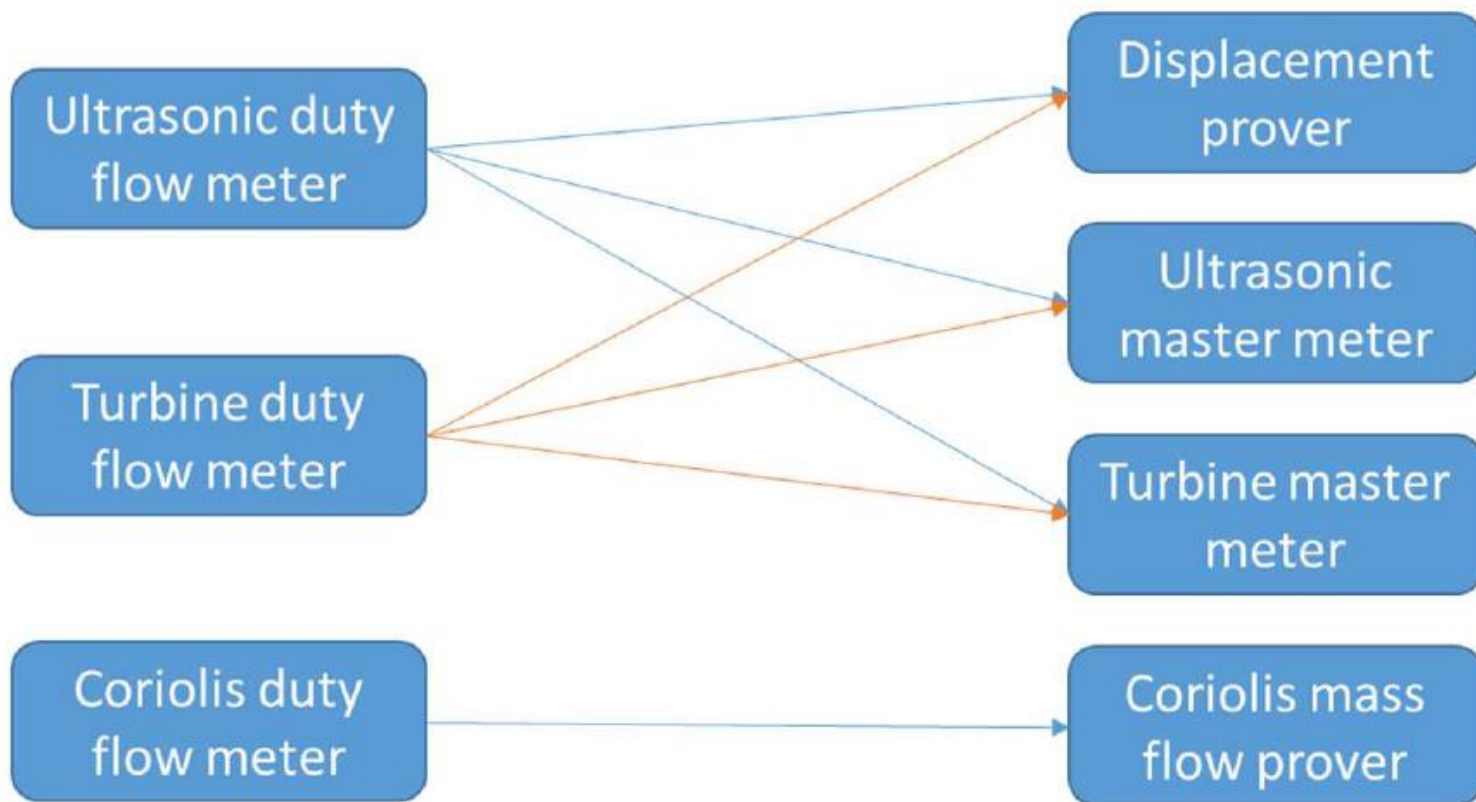
n

The screenshot shows the configuration interface for a stationary prover. The 'Stationary Prover / Master Meter' section is active. The 'Type of device:' dropdown menu is open, showing options: DisplacementP (selected), Ultrasonic, Turbine, and DisplacementProver. The 'Temperature' and 'Pressure' dropdowns are both set to 'Single'. A schematic diagram below shows a 'Displacement Prover' connected to a line with temperature (T_p) and pressure (P_p) sensors.

Olje – Valgmuligheter for måleteknologi

Primary flow meter

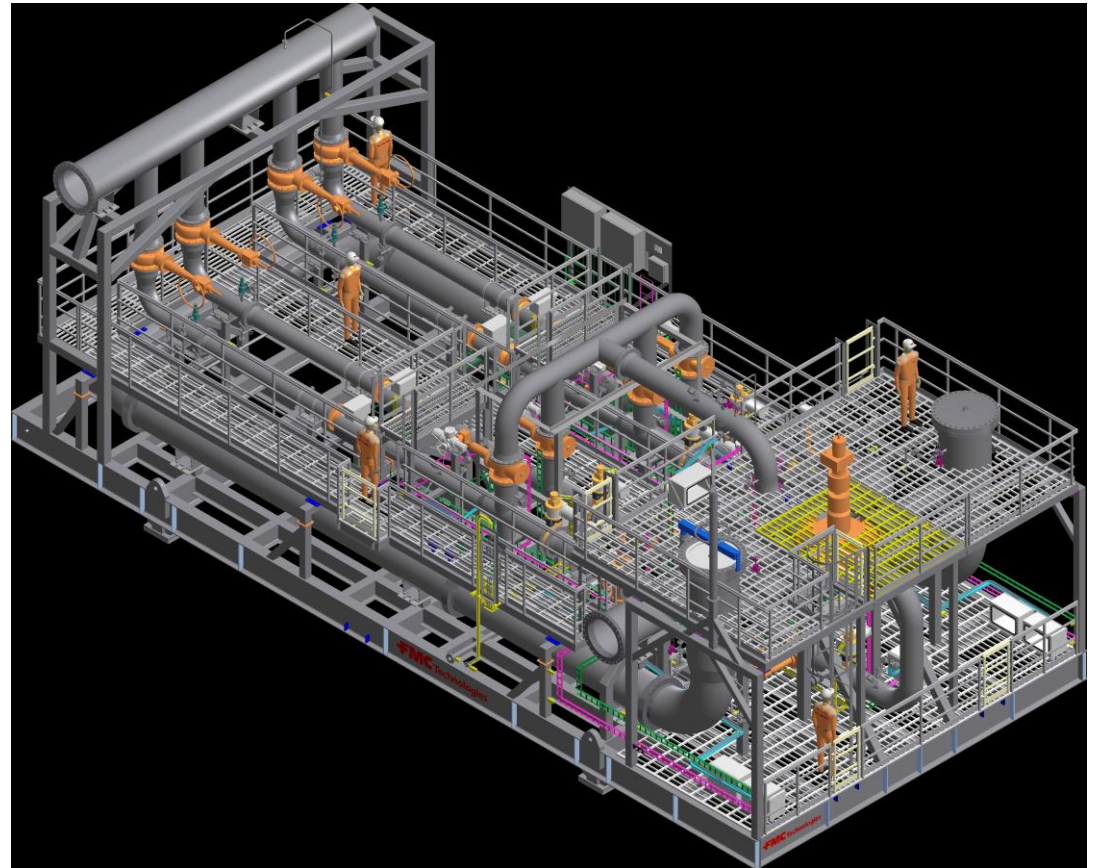
Proving device



Målestasjon med turbinmåler

Eksempel

- Oljelastestasjon
- Kapasitet 7500 m³/t
- 4 x 12-tom turbinmeter
- 30-tom rørnormal
- Automatisk prøvetaker for tetthet og vann-i-olje



<https://nfogm.no/handbooks-and-uncertainty-programs/>

Målestasjon med turbinmåler

Fiscal Oil Metering Station Uncertainty Tool

metering station oil equipment proving metering results charts plots report

Configuration of the metering station

Temadag 2018 26.01.2018 Turbinmeter Stasjon

Flow Meter		Stationary Prover / Master Meter		Densitometer	
Flow Meter type:	Temperature	Type of device:	Temperature	Densitometer:	
Turbine	Single	DisplacementP	Single	Laboratory	
	Pressure		Pressure		
	Single		Single		

Målestasjon med turbinmåler

▲ Turbine Meter, Standard Volume Flow

Functional Relationship

$$q_{v0, meas} = A_{liq}^{m, \Delta p} A_{steel}^{m, \Delta p, c} q_{nom, flowmeter}^{metering} \left(\frac{V_{nom, prover}^{proving}}{V_{nom, flowmeter}^{proving}} \right) \left(\frac{V_{0, ref}^{calibration}}{V_{0, nom, prover}^{calibration}} \right)$$

Uncertainty Element	Uncertainty	Unit	Confidence	Std. Uncert. u_i	Sens. Coeff. s_i	Variance ($s_i \cdot u_i$) ²
Volume Correction factor AliqmΔp	0.0591	%	95% (norm)	0,0296 %	1,000 E+0	8,744 E-4 (%) ²
Volume Correction factor Asteel	0.0005	%	95% (norm)	0,0002 %	1,000 E+0	5,359 E-8 (%) ²
Flow meter repeatability at proving	0.027	%	95% (norm)	0,0135 %	1,000 E+0	1,823 E-4 (%) ²
Displacement Prover uncertainty at proving	0.04	%	95% (norm)	0,02 %	1,000 E+0	4,000 E-4 (%) ²
Metering Uncertainty, Emet	0.0694	%	95% (norm)	0,0347 %	1,000 E+0	1,204 E-3 (%) ²

Sum of variances, $\Sigma (s_i \cdot u_i)^2$

0,0027 (%)²

Relative Combined Standard Uncertainty

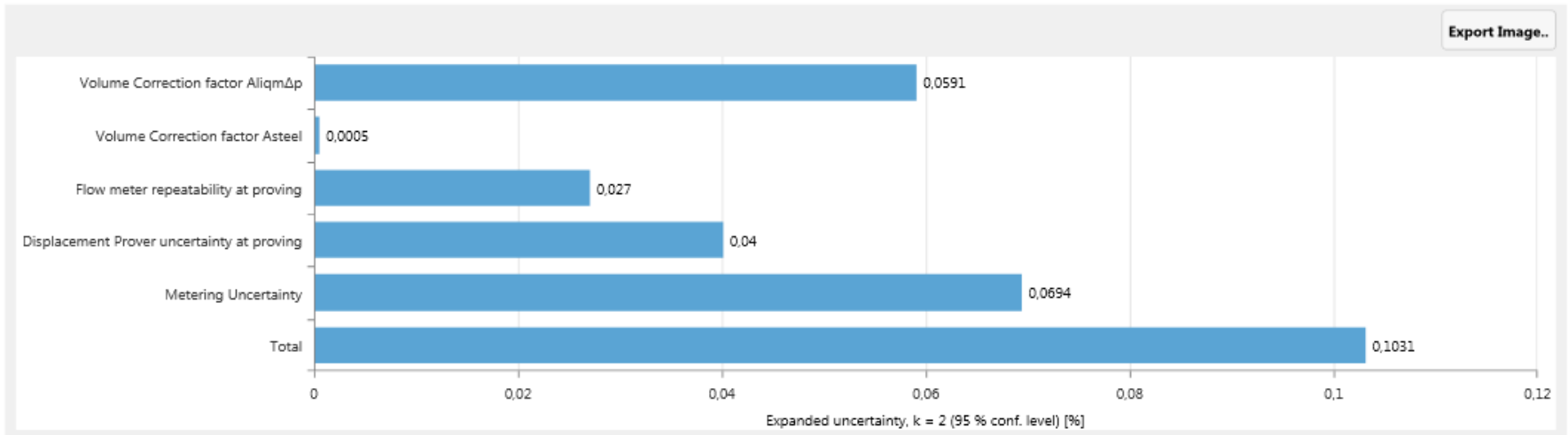
0,052 %

Relative Expanded Uncertainty (95% Confidence level, k=2)

0,103 %

Målestasjon med turbinmåler

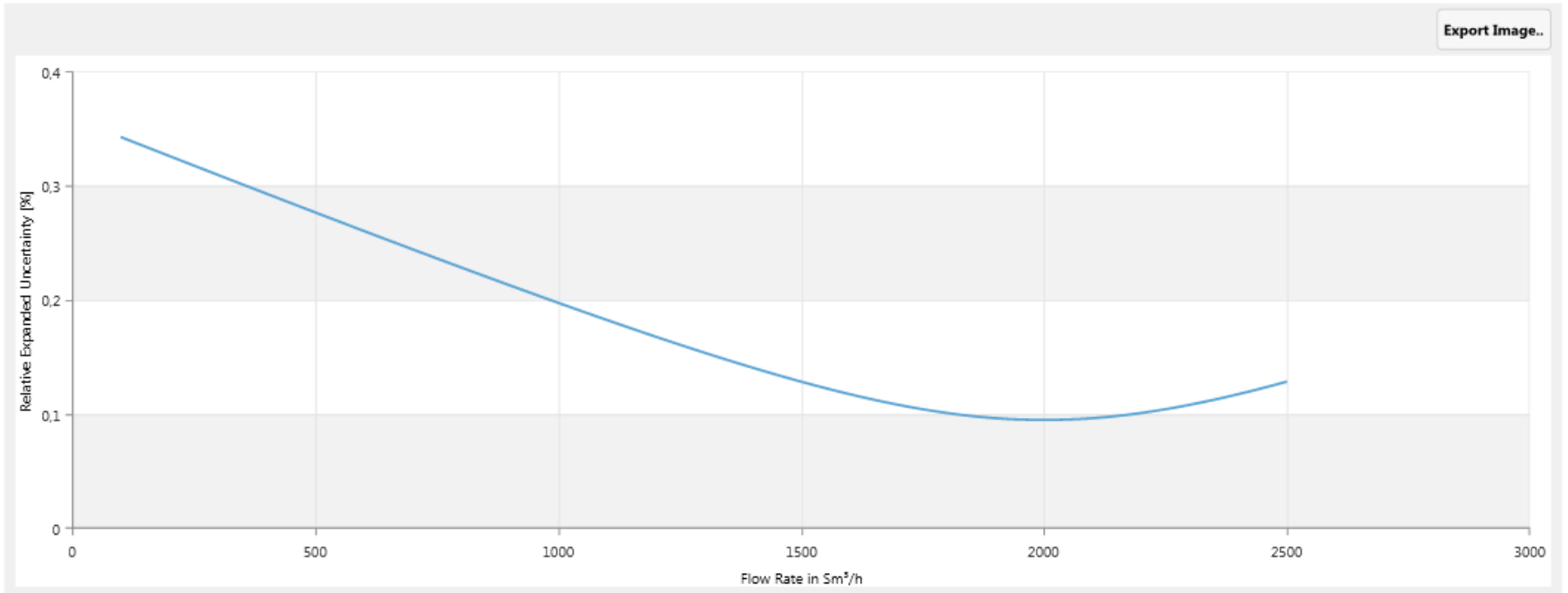
Turbine Meter, Standard Volume Flow



Målestasjon med turbinmåler

Turbine Meter, Standard Volume Flow

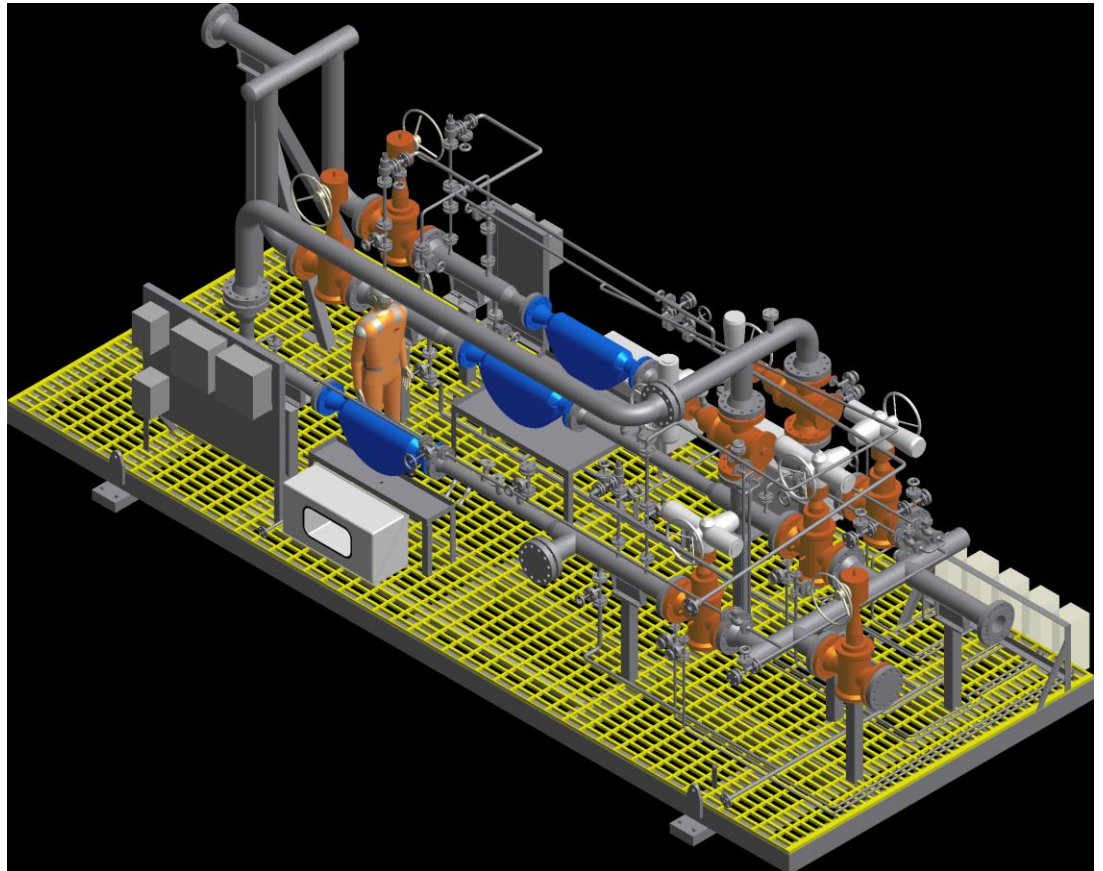
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Målestasjon med coriolismåler

Eksempel

- Kontinuerlig måling
- Kapasitet 250 m³/t
(200 tonn/t)
- 2 x 4-tom coriolismåler
- 1 x 4-tom coriolis mastermeter
- Online tetthet




<https://nfogm.no/handbooks-and-uncertainty-programs/>

Målestasjon med coriolismåler

Fiscal Oil Metering Station Uncertainty Tool

metering station oil equipment calibration proving metering results charts plots report

Configuration of the metering station

Temadag 2018 26.01.2018  Coriolis Målestasjon

Flow Meter

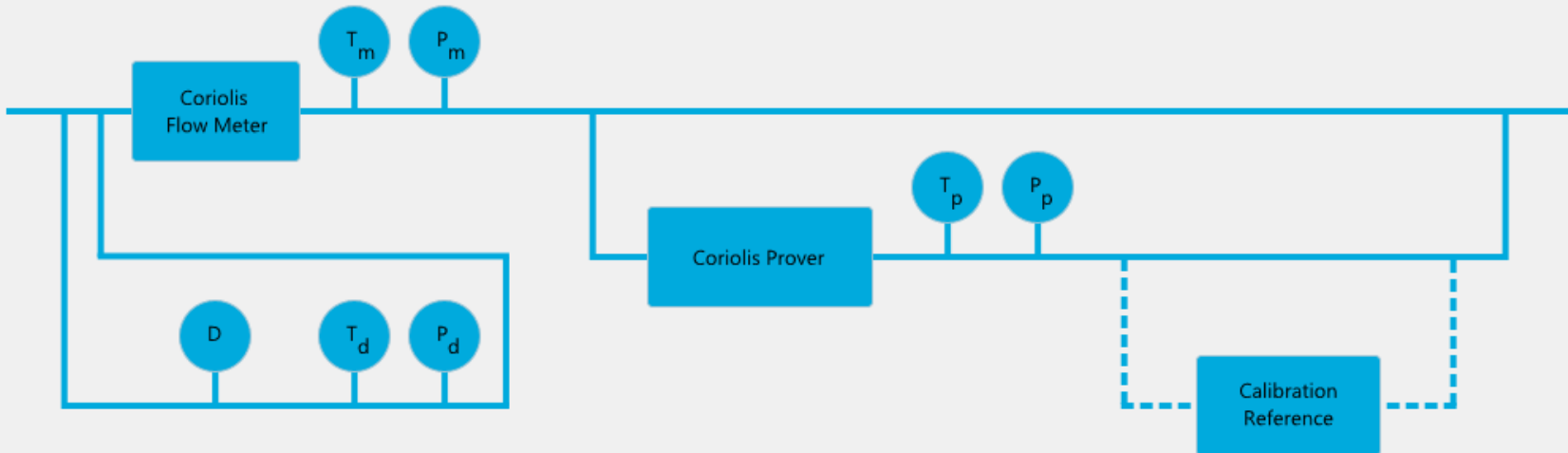
Flow Meter type: Temperature
 Coriolis Pressure

Stationary Prover / Master Meter

Type of device: Temperature
 Coriolis Pressure

Densitometer

Densitometer: Temperature
 Single Pressure



Målestasjon med coriolismåler

Coriolis Meter, Standard Volume Flow

Functional Relationship

$$q_{v0, meas} = \frac{C_{tld}^{met} C_{pld}^{met}}{\rho_{dens}} q_{m, flowmeter} \left(\frac{M_{prover}^{proving}}{M_{flowmeter}^{proving}} \right) \left(\frac{M_{ref}^{calibration}}{M_{prover}^{calibration}} \right)$$

Uncertainty Element	Uncertainty	Unit	Confidence	Std. Uncert. u_i	Sens. Coeff. s_i	Variance ($s_i \cdot u_i$) ²
Volume Correction factor C _{tld} -C _{pld}	0.0811	%	95% (norm)	0,0405 %	1,000 E+0	1,643 E-3 (%) ²
Densitometer, ρ	0.063	%	95% (norm)	0,0315 %	1,000 E+0	9,929 E-4 (%) ²
Master meter repeatability at calibration	0.027	%	95% (norm)	0,0135 %	1,000 E+0	1,823 E-4 (%) ²
Calibration reference uncertainty	0.1	%	95% (norm)	0,05 %	1,000 E+0	2,500 E-3 (%) ²
Flow meter repeatability at proving	0.027	%	95% (norm)	0,0135 %	1,000 E+0	1,823 E-4 (%) ²
Master meter repeatability at proving	0.027	%	95% (norm)	0,0135 %	1,000 E+0	1,823 E-4 (%) ²
Flow profile and fluid effects on master meter	0.05	%	95% (norm)	0,025 %	1,000 E+0	6,250 E-4 (%) ²
Uncertainty contribution from difference in proving flow rate and calibration flow rates	0.0012	%	95% (norm)	0,0006 %	1,000 E+0	3,345 E-7 (%) ²
Uncertainty contribution from difference in pressure at proving and calibration	0.2	%	95% (norm)	0,1 %	1,000 E+0	1,000 E-2 (%) ²
Uncertainty contribution from difference in temperature at proving and calibration	0	%	95% (norm)	0 %	1,000 E+0	0,000 E+0 (%) ²
Flow meter repeatability at metering	0.0309	%	95% (norm)	0,0154 %	1,000 E+0	2,385 E-4 (%) ²
Flow profile and fluid effects on flow meter	0.05	%	95% (norm)	0,025 %	1,000 E+0	6,250 E-4 (%) ²
Uncertainty contribution from difference in metering rate and proving rate	0.0693	%	95% (norm)	0,0346 %	1,000 E+0	1,200 E-3 (%) ²
Uncertainty contribution from difference in pressure at metering and proving	0	%	95% (norm)	0 %	1,000 E+0	0,000 E+0 (%) ²
Uncertainty contribution from difference in temperature at metering and proving	0	%	95% (norm)	0 %	1,000 E+0	0,000 E+0 (%) ²

Sum of variances, $\Sigma (s_i \cdot u_i)^2$

0,0184 (%)²

Relative Combined Standard Uncertainty

0,136 %

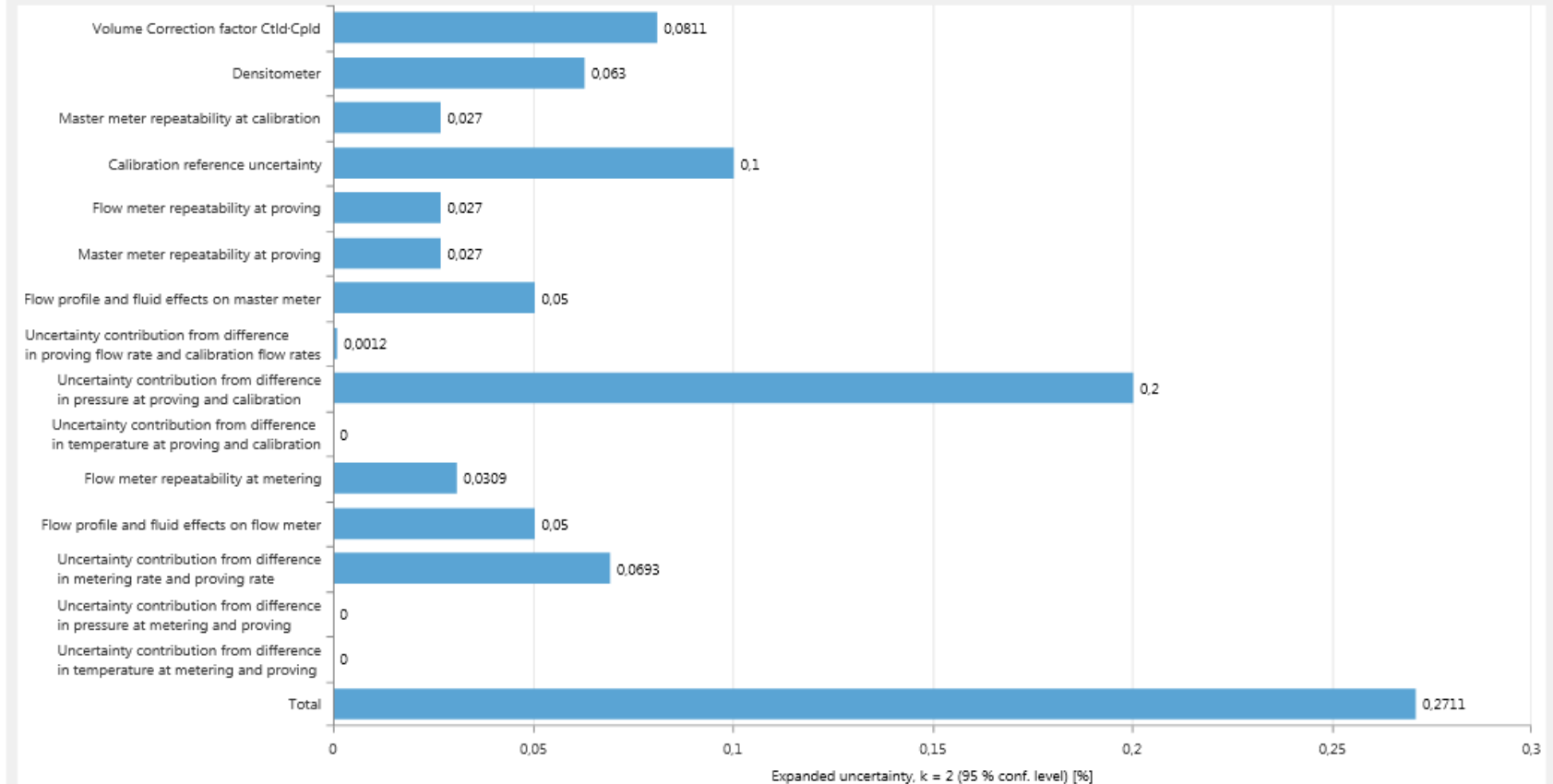
Relative Expanded Uncertainty (95% Confidence level, k=2)

0,271 %

Målestasjon med coriolismåler

Coriolis Meter, Standard Volume Flow

Export Image..



Målestasjon med coriolismåler

Coriolis Meter, Standard Volume Flow

