Two years of fiscal performance by the liquid 5 path Krohne Altosonic-V ultrasonic meter at the Vigdis/Snorre Crossover oil measurement station

Maron J. Dahlstrøm, Saga Petroleum ASA

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by the liquid 5 path Krohne Altosonic-V ultrasonic meter at the Vigdis/Snorre Crossover oil measurement station

NSFMW -99

Paper 5

25-28 October 1999

Maron J. Dahlström

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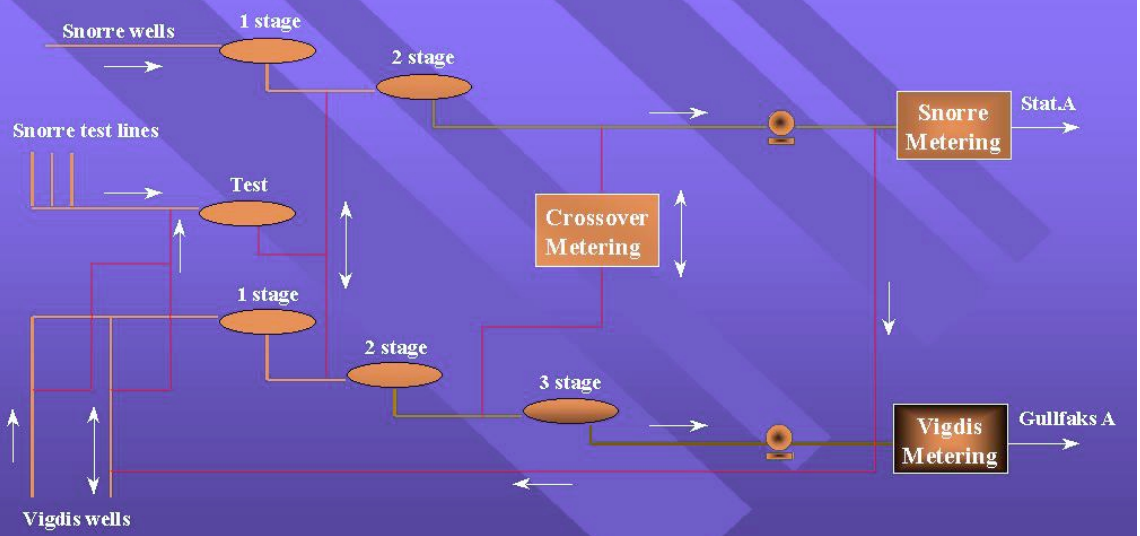
Snorre/Vigdis oil process outline



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Use liquid ultrasonic meter correctly !

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- The ultrasonic liquid meter can output a flow modulated frequency similar to the turbine meter. But, the USM can not be calibrated the same way as a turbine meter : Long time and large volume is required to establish Meter Factor or K-factor. Used directly with a regular prover, hundreds of trials are required for stochastic methods. We now use 1 hour synchronized pulse count.
- In-situ calibration connection ; 4 " 90 degree T 10 D upstream of USM Master resulted in +/- 7% variation in reading, at constant flow. USM need natural profile.
- Master meter installed 10 D after 90 degree bend resulted in some swirl and unwanted offset in flow !

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Ultrasonic liquid meter basic unlinearity

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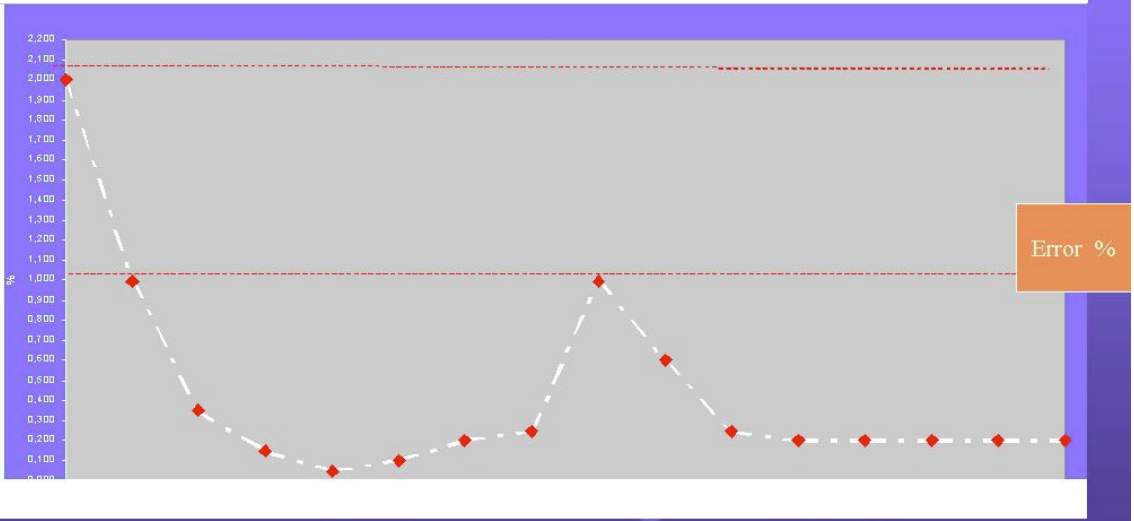
Never activate Reynolds number compensation, with Reynolds number calculated from entered faulty viscosity ! This mistake resulted in approximate 1 % offset. Note that Snorre/Vigdis Crossover operates in the almost constant effect region.



Typical error compensation curve, with significant error compensation in lower Reynolds number region

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Crossover Metering connections

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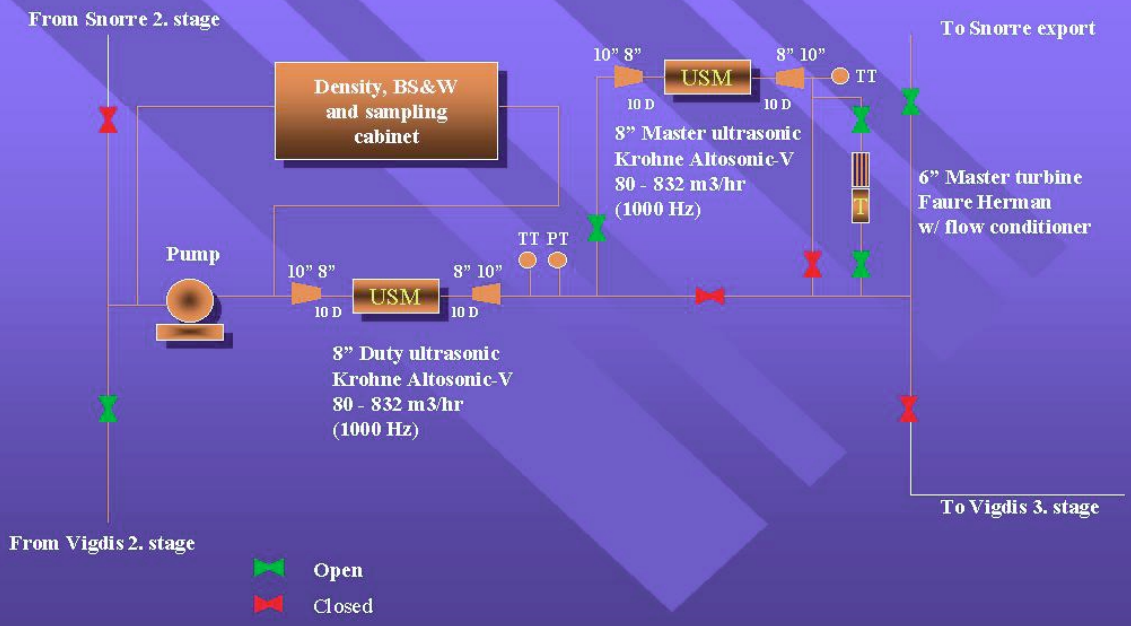
Modified with new connection for reference turbine downstream USM



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Duty ultrasonic meter calibrated with Master turbine meter 1998

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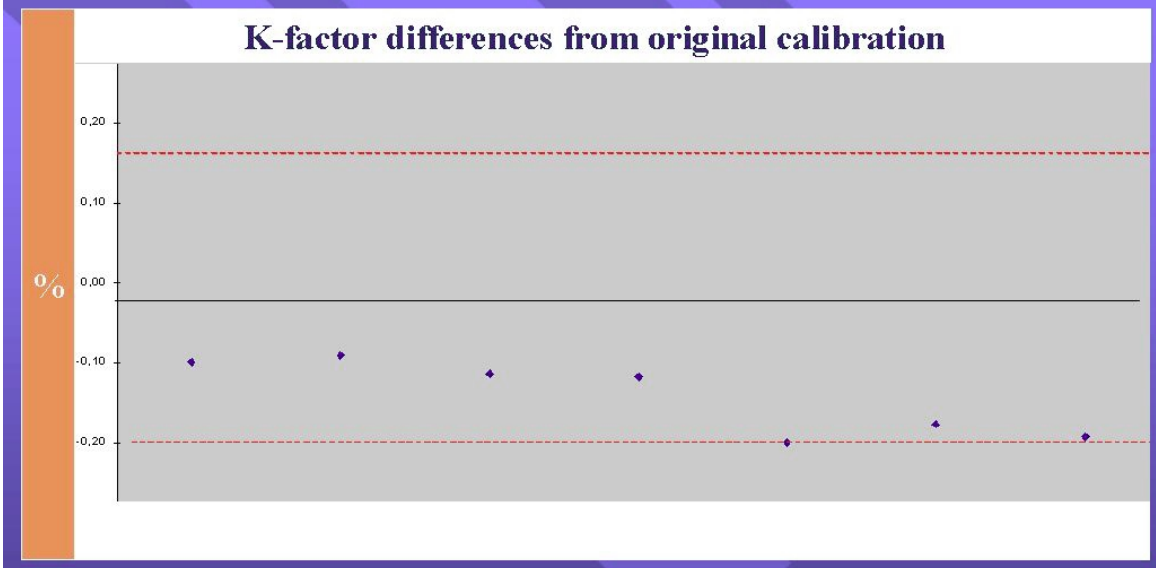

Flowrate approx 220 m3/hr; difference -0,12 % from original K-factor (4326.9)

Flowrate approx 260 m3/hr; difference -0,19% from original K-factor

Hourly results repeats within 0,025 % band

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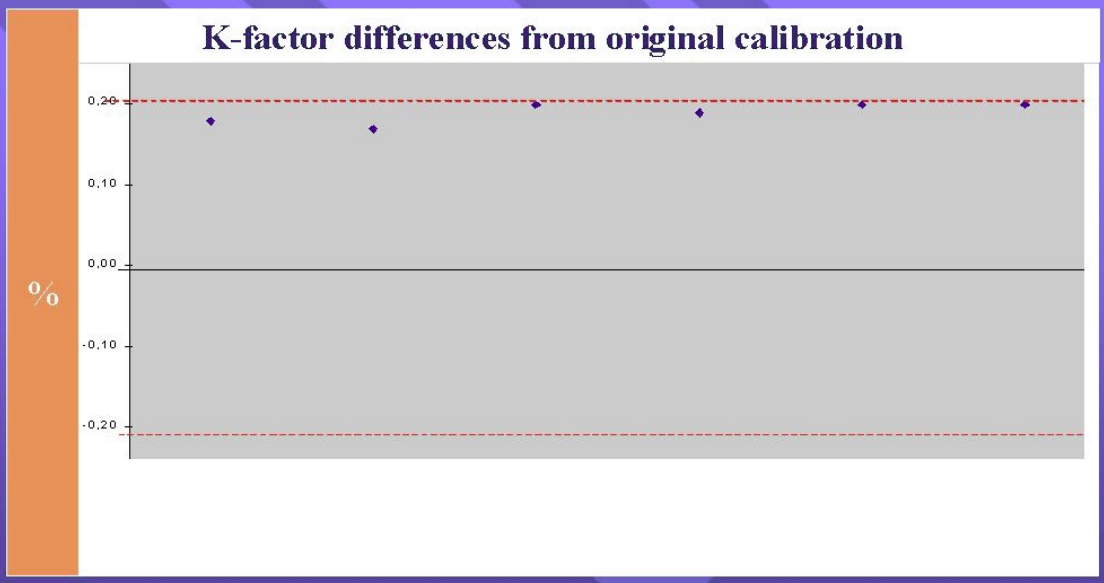
Duty ultrasonic meter calibrated with Master ultrasonic meter 1998



Flowrate approx. 216 to 260 m3/hr; difference + 0,19 % from original K-factor (4326,9)
Hourly repeats inside 0.03 % band

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Improvements in 1998

- **The swirl measurement for the Master ultrasonic meter showed more swirl than expected. Krohne therefore activated a swirl effect compensation, based on the swirl factor measurement. This improved the uncertainty, however with some consequences for repeatability.**
- **Based on the NMI certificate, Krohne removed the meter material temperature compensation.**
- **Verification was carried out with Master turbine meter as in the previous tests.**

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New results after swirl compensation 1998

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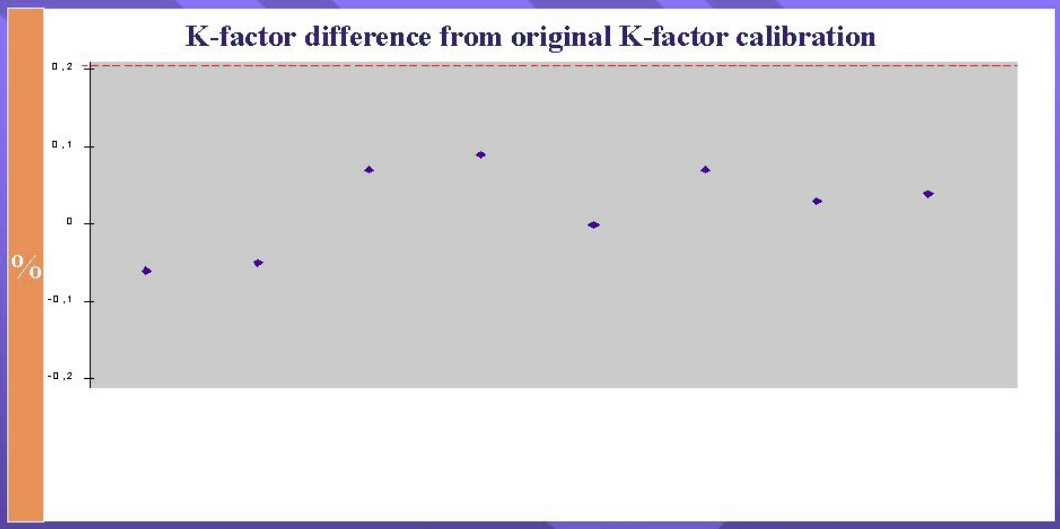
Duty ultrasonic calibrated with Master turbine meter



Flowrate approx. 130 m3/hour; difference -0,06 %
Flowrate approx. 270 m3/hour; difference +0,04 %
Flowrate approx. 200 m3/hour; difference +0,09 %

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New results after swirl compensation 1998

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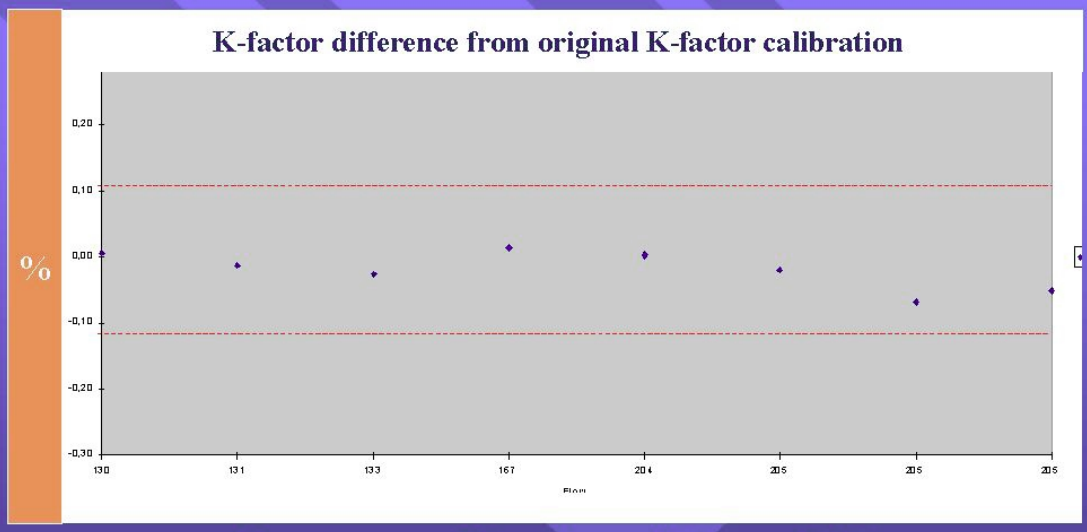
Duty ultrasonic meter calibrated with Master ultrasonic meter



Flowrate approx. 130 m3/hour; difference -0,03 %
Flowrate approx. 170 m3/hour; difference +0,01 %
Flowrate approx. 200 m3/hour; difference -0,07 %

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Master turbine meter verification 1998

- Examination of the possible bias for the Faure Herman helical rotor turbine meter (linearity +/- 0.01%) from change in flow profile, indicates that this shift normally will be less than 0.2 % .
- Since the K-factor curve for the master turbine meter with upstream section and flow conditioner, still can shift in a new location, the master turbine meter was therefore verified in-situ.

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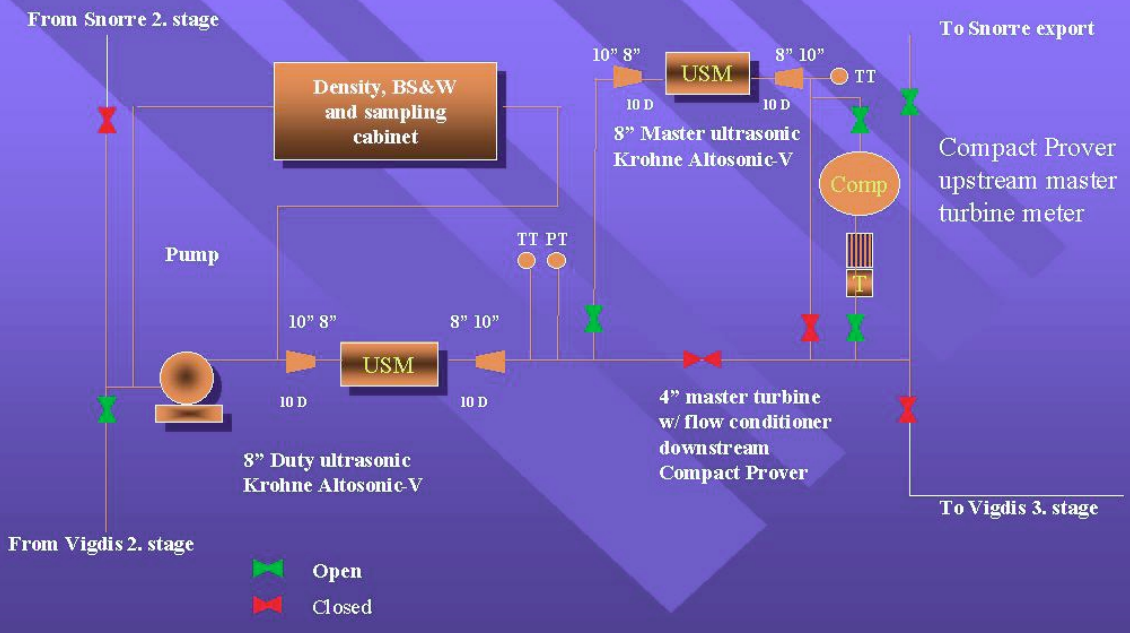
Crossover Metering calibration 1998

Compact Prover downstream USM and with turbine meter afterwards



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In-Situ calibration performed with Compact Prover & Master turbine meter 1998

- Con-Tech Compact Prover with downstream master turbine meter temporarily installed with flexihoses between the master turbine meter run connections.
- Master and Duty ultrasonic meter was calibrated with the master turbine meter. Both ultrasonic meters showed a shift in K-factor curve. The master meter position for this purpose is therefore questioned.
- 1999 performance still show all results for the Duty meter inside 0,10 % from the calibration. All results for Duty meter K-factor is well inside 0,10 % from previous K-factor.

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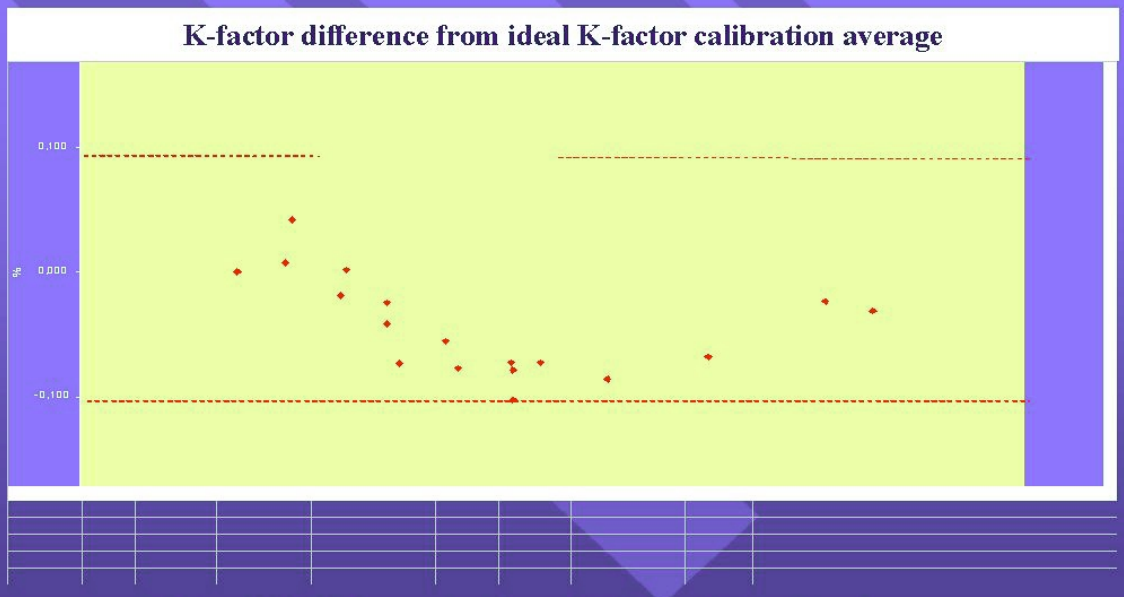
1999 performance

Duty ultrasonic meter calibrated with Master ultrasonic meter



All Duty USM K-factors inside +/- 0,10 from 1998 calibration average

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Performance

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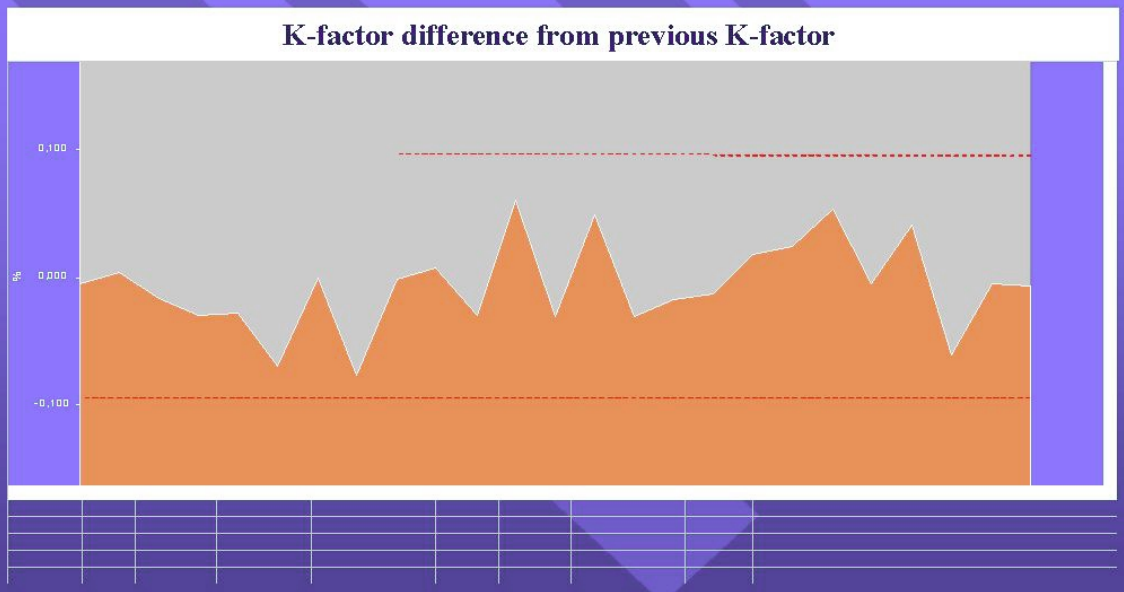
Duty ultrasonic meter calibrated with Master ultrasonic meter



All Duty USM K-factors inside +/- 0,10 from previous K-factor

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In-Situ calibration to be performed with Compact Prover & master turbine meter run 1999

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- A turbine meter run is calibrated at the Snorre export oil metering station and moved to the position down-stream of the Master USM. This turbine will then be in-situ calibrated with the Con-Tech Compact Prover, temporarily installed between the master turbine meter and the return connection.
- Synchronized pulse count for the Master ultrasonic meter and the master turbine meter over one hour will be repeated for each flow point, while the average turbine meter K-factor is determined with the Compact Prover.

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Crossover Metering calibration 1999

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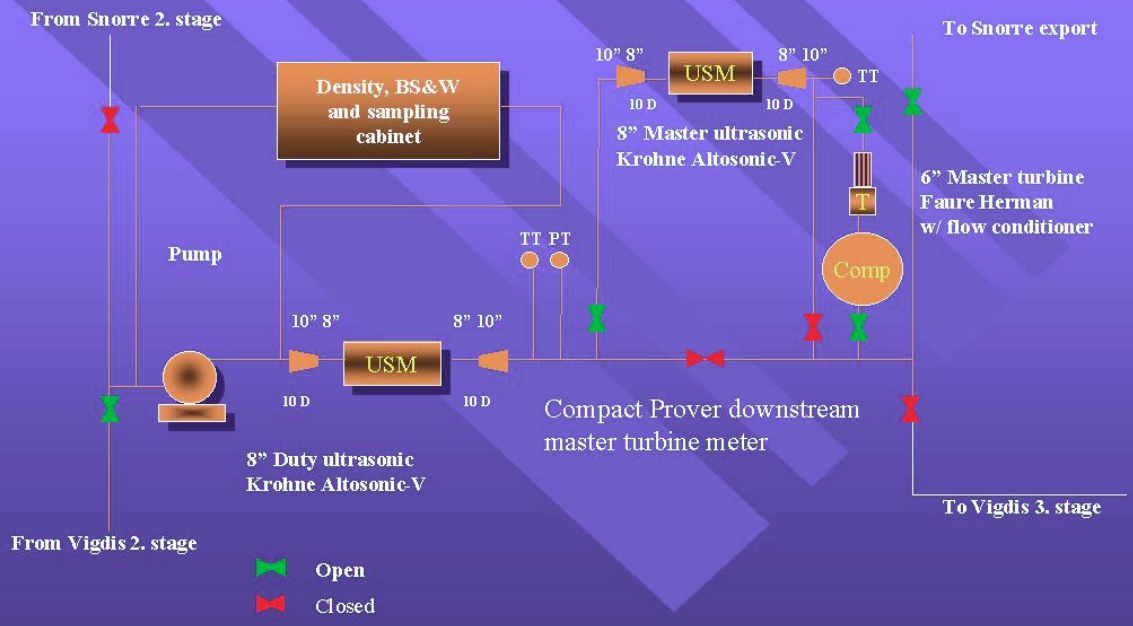
Reference turbine downstream USM and with Compact Prover afterwards



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1999 Prover calibration

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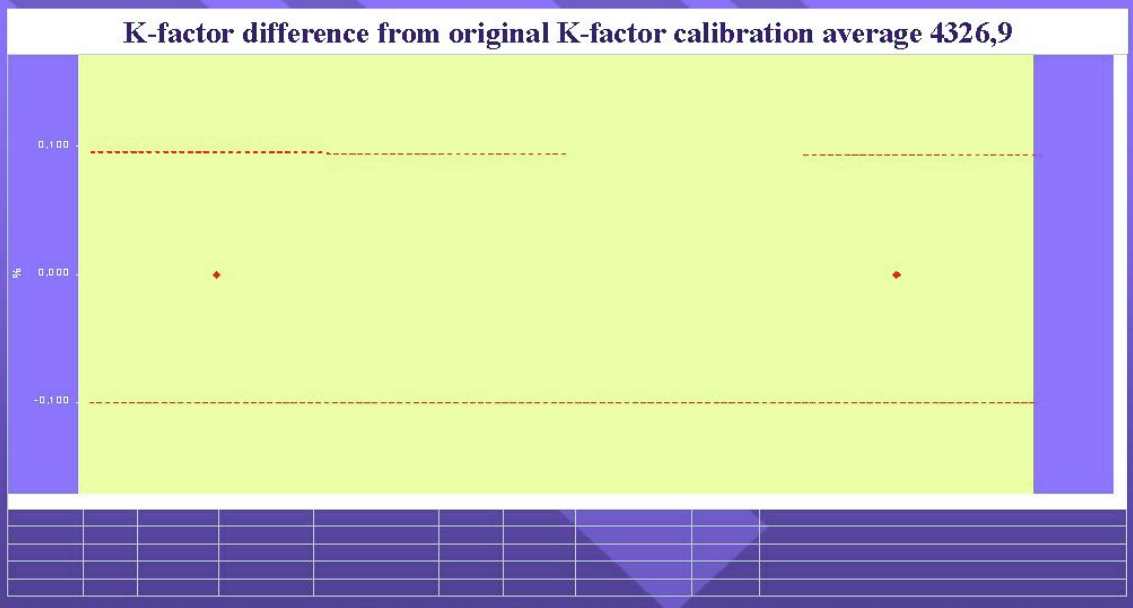
Master ultrasonic meter calibrated with master turbine meter



Comparison data available in November -99

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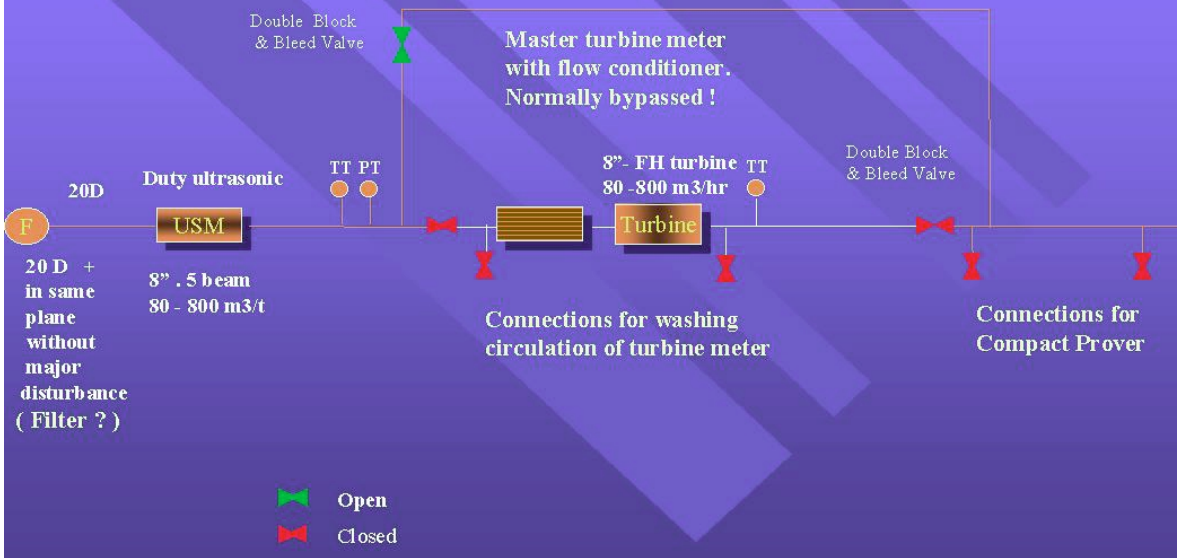
Snorre B configuration :
Fiscal measurement station for oil with USM



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Snorre B calibration philosophy

- The Faure Herman master turbine meter will be calibrated in-situ with regular intervals (initially every 2nd month with Compact Prover temporarily installed into the fixed piping arrangement. The master turbine meter K-factor curve is entered into the Snorre B calibration flowcomputer
- Duty ultrasonic meter is calibrated with the master turbine meter, while verified with the Compact Prover, in a syncronized count of pulses over longer time. Duty USM K-factor curve is entered into the Duty flowcomputer.

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Snorre B calibration philosophy

- In the operational period between Compact Prover calibration, the Duty USM meter factor will be verified with the turbine meter in a syncronized count of pulses.
- We are considering to use the Duty USM meter factor determination for Compact Prover calibration period alert only, since data indicates that the USM is more reliable than a turbine meter !

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