

Norske Sivilingeniørers Forening

Measurement of Gas and Liquids

7. - 10. juni 1982

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## THE COST OF SYSTEMATIC ERRORS

In accordance with good and accepted principles of teaching, I will use my part of the opening lecture to motivate you for this course.

One of the ways to do this, may be to quantify the effects of metering errors in terms of money.

Let us look into the money-flowrate of the metering systems used in connection with production of oil and gas from the continental shelf:

- A typical flowrate for an oil metering system is 300 000 BPD. At current prices, this is equivalent to a gross flow of money of the order of 60 million Nkr/day or 22 billion Nkr/year
- A typical flowrate for a gas metering system is 40 million SCMD. At current prices this is equivalent to 40 million Nkr/day or 14 billion Nkr/year.

These flowrates of money can be combined with the relevant percentage of systematic error in the metering system, and the economical effects of bad metering will become evident. Let us have a quick look at potential sources of systematic error in gas measurement. I will limit myself to two examples:

### Errors in density metering

A little simplified, the flowrate through an orifice meter for gas is calculated as:

$$Q_m = \text{Constant} \times \sqrt{\text{Diff.pressure} \times \text{Density}}$$

Normally, the conditions are so that it is necessary to measure density by a densitometer. One of the problems with densitometers are that you cannot locate its sensor in the gas stream at the upstream pressure tapping, where it should be ideal. So the sensor of a densitometer is located somewhere else, in a by-pass or downstream of the orifice plate. A limited number of different arrangements are in use in custody-transfer metering systems. Experience has shown, however, that at least one of these arrangements can change the temperature of the gas to such an extent that a systematic metering error of 0.2 - 0.3% can occur. This will be an ever lasting error in the metering system and will represent up to 4,3 million Nkr/year for the gas metering system above.

#### Errors caused by meter-tube and orifice plate

Shown on the overhead projector is a table of errors caused by non-standard conditions of orifice plate or metertube for a 4-inch meter. Since the exact basis for the numbers are not given, the % difference must not be regarded as generally correct for all metering systems. It should be noted, however, that a liquid build up in the metertube may cost the seller of gas the sum of 4,5 million Nkr/day.

## References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.