



# NORTH SEA FLOW MEASUREMENT WORKSHOP IN OSLO ON THE 25 - 28TH OCTOBER, 1999

OPENING ADDRESS BY DR BOB PETERS - DANIEL EUROPE LTD

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*"You are young my son, and, as the years go by, time will change, and even reverse many of your present opinions. Refrain therefore awhile from setting yourself up as a judge of the highest matters"*  
Plato

## 1. INTRODUCTION

At the end of the millennium and at the start of the 21st Century, I believe it is forgivable to look back at what has been achieved in the North Sea, since the first joint meeting in 1982 in Stavanger. However it would be quite unforgivable if we did not look forward into the millennium and try to envision what may be achieved in flow measurement in the next century.

In this period of change, when we move from the 20th Century to the 21st Century and when the Crine initiative and cost reduction is the name of the game, it has been necessary for companies to amalgamate e.g. BP/Amoco and Arco; Statoil and Saga; Kongsberg and FMC; Daniel and Fisher-Rosemount.

We even changed the site of the North Sea Flow Measurement Workshop this year to this wonderful facility here in Gardermoen.

Those of us in the flow measurement world must also be prepared for change in the way we do business. However it is to be hoped that, as engineers, it will not be simply change for change sake, but rather technical change, carefully assessed and tested, resulting in improved techniques.

## 2. THE FIRST MEETING ON "MEASUREMENT OF GAS AND LIQUIDS"

It was held in the Atlantic Hotel in Stavanger from the 7th to the 10th June 1982. The meeting was organised by Norwegian Society of Chartered Engineers and the Rogland Regional College, in conjunction with N.P.D., Norwegian Service of Legal Metrology, Gas Metering Department Netherlands. The Registration Fee in 1982 was 3,300 NOK compared to 6,200 NOK for this year. For the 1st year of the North Sea Flow Metering Workshop in 1983 the cost was 4,500NOK so it appears that we have a bargain this year.

The length of the conference was virtually the same - two and a half days with about 14 papers compared to 27 this year. However we work much harder now, starting at 8.30 am, whereas in the early days it was 9.00am.

They also knew how to enjoy themselves 17 years ago with a shellfish party on the beach - but it was in early June. These were the "good old days" as recently we have been exposed to wolves in a dark October night in Kristiansand.

At that Seminar there were 33 delegates plus 9 lecturers and a committee of 5. It is interesting to look at the names and to see how many are still active in the metering world

### 1982 Attendance List

GRO AKSNES	STATOIL
LEIF INGE ANDERSEN	A/S NORSKE SHELL
BJARNE BANG	DANISH ENERGY AGENCY
MARON DAHLSTRØM	PHILLIPS PET.
NUSTRAL DANIR	PETRONAS CARRIAGLI
BILLY GRANT	PHILLIPS PET.
LARS OLAV HOLEN	SUPERIOR OIL NORGE
PER HÆGSTAD	A/S NEBB
PETTER INGEBERRG	SIVILING HELGE INGEBERG
EDGAR B JOHANNESSEN	NILS A. STANG
NILS BJØRN JORDAL	SAGA PET.
ALF R.KLUGE	STATOIL
KARL MARTIN KRISTIANSEN	STATOIL
OLAF KRISTIANSEN	NORSKE HYDRO
SVEINUNG MYHR,	NORSKE HYDO
SVEINUNG NILSEN	STATOIL
FINN PAULSEN	OLJEDIREKTORATET
ROBERT PETERS	DANIEL
ARNE ROALD	NORSK A/S PHILIPS
ROLF RØNNING	PETRONAS CARRIAGALI

ISMAIL SAID  
MORTEN SAXVIK  
OLAV SELVIGVÅG  
SIGBJØRN SOLBAKKEN  
E.A SPENCER  
SVERRE STENVÅG

PETRONAS CARRIAGALI  
STATOIL  
OLJEDIREKTORATET  
OLJEDIREKTORATET  
NEL  
ELF AQUITAINE NORGE A.S.

DAG THOMASSEN  
TOR ARNE THORSEN  
ØYSTEIN B.TUNTLAND

INST. FOR ENERGITEKNIKK  
KVAERNER  
ROGLAND DISTR.HØGSKOLE

REIDAR VIK

NORPIPE PET.

GUNNAR WEDVICH  
KARSTEIN WERGELAND

CHR. MICHESENS INST.  
OLJEDIREKTORATET

TORE ØGLÆND

OLJEDIREKTORATET

**COMMITTEE:**

ARILD BØE  
HARALD DANIELSEN  
KRISTEN HELLERUD  
CP HOEKS

ROGLAND DISTR.HØGSKOLE  
OLJEDIREKTORATET  
JUSTERDIREKTORATET  
NORSK HYDRO

**LECTURERS:**

H BELLINGA  
KNUT BIRKELAND  
PETER A.M.JELLS  
GEIR M.NESBAKKEN  
HALLVARD TUNHEIM  
OLAV VIKANE  
PAULWILCOX

GASUNIE  
JUSTERVESENET  
MOORE, BARRETT & REDWOOD  
NORSK HYDRO  
ELF AQUITAINE NORGE A.S.  
ROGLAND DISTR.HØGSKOLE  
TOTAL OIL MARINE

**ADMINISTRATION:**

JOHAN ASMUNDVAAG  
MERETE JACOBSEN

NORSKE SIVILINGENIØRERS FORENING  
NORSKE SIVILINGENIØRERS FORENING

It is also sad to note that one or two have died, for example Dr Tony Spencer who was so keen to continue from this first meeting to having an annual meeting, alternating between Norway and Scotland.

The International flavour of the Meeting was obvious even then, with delegates from Norway, Denmark, the U.K. and the Netherlands but in addition there was 2 from Malaysia. With the meeting resulting in the first Flow Metering Workshop in 1983. Although the majority continues to be Scandinavian and U.K. personnel, there has been an increasing International representation and now we have a significant number from North America.

The North Sea Flow Measurement Workshop has come of age and has contributed greatly to the effective flow measurement in this environment. It has stimulated ideas, encouraged the exchange of views as well as forming business and friendship ties which have been maintained over the intervening period.

### **3. PAPERS PRESENTED AT THE MEETING IN 1982**

The opening address was entitled "Planning under harder Economic Conditions" by Mr Arne Rettedal, Minister, in the Ministry of Local Government and Labour. - Some things never change, if he was giving the same paper today I wonder if the title would remain the same?

Papers followed this, from Harald Danielsen and Knut Birkeland, which highlighted the economic advantages of accurate metering. A similar paper could be given today. There were papers on orifice metering, vortex meters, turbine meters, provers, computers, LPG Measurement and ultrasonic metering, finally Jan Bosio presented a paper on sonic nozzles.

It was interesting to note that Ultrasonic Meters were being considered in 1982, but it took until fairly recently for Daniel and British Gas to introduce their ultrasonic gas meter onto the market, and more recently to have the ultrasonic liquid meter used for Fiscal purposes.

NOTE: there was no mention of Multi-Phase Meters in these days but Coriolis Meters were being considered. In a paper on initial tests on the Coriolis Meter it was reported that the tube broke after 4 days operation in the laboratory. Early findings like this set the Coriolis Meter back for a number of years but these problems have been overcome and one of the meter manufacturers can claim a "Mean Time Between Failure" of greater than 1.0 million hours

### **4. DEVELOPMENTS FROM THE FIRST WORKSHOP IN 1983**

This year there are 12 Multi-Phase Meter presentations and 12 ultrasonic presentations with 2 uncertainty papers and we still have managed to keep one orifice meter paper which shows the old orifice is still pulsing away.

Remember the tremendous rate of change in technology over this period. In 1983 we did not have PC's and if nothing else you only have to look at the quality improvement of the papers and the presentations to see the effect of that development.

In the field of process control Halvard Tunheim presented a paper in 1982 for the Elf Frigg Flow Measurement System where he used intelligent stream flow computers. These systems have dramatically reduced the computational error in flow measurement.

Technology has advanced at a significant rate over this period. It should be remembered that in these early days the driving force in the North Sea was to develop the technology to extract the hydrocarbons as rapidly as possible to enable the operating companies to get a quick return on investment.

This had the effect that metering costs were not as closely examined as they are today. Today there is in an atmosphere of cost cutting, CRINE Initiatives etc. It must be remembered that, the uncertainty of measurement is the invisible cost of metering.

However, more visible costs include cost of ownership (CAPEX and OPEX etc) and there has been big changes in this area with the concept in Norway of "Conditioned Based Maintenance".

This appears to be the perfectly logical conclusion for the desired goal of unmanned platforms and it does appear that the Norwegian sector has taken a much longer-term view with their philosophy, which foresees the effect of unmanned platforms in the future.

The workshops have reflected the changes through the years.

In 1988 Nolan, O'Hare and Peters presented the first practical gas ultrasonic paper.

10 years ago in 1989 flare as papers were still being presented using turbine meters and there was one paper on wet gas measurement and one on water in oil sampling.

1990 was the year where we started to see a dramatic change in emphasis. There were a number of Coriolis papers including gas measurement. There were 7 Multi-Phase metering papers - it had taken off on the road to the 12 this year.

## **5. ASSESSMENT OF METERING DEVELOPMENT IN THE PAST 17 YEARS**

It has been an exciting time in flow measurement terms since the North Sea Workshop was established. We have seen the Coriolis Meter and the Ultrasonic Gas Meter grow from virtually nothing to very major contributors to metering. Now we see the ultrasonic liquid meter develop into a possible fiscal meter.

Other meters' popularity has risen and fallen e.g. Orifice, Liquid and Gas Turbine Meters, vortex meters have fallen and now Venturi Meters, which were declining in use, are apparently enjoying a resurgence in the field of wet gas metering and are also being incorporated into Multi-Phase Meters.

It is a case of "horses for courses" and the appropriate meter must be supplied:

- for the prevailing flow conditions,
- for the technical expertise available
- for the local economic situation.

I have questioned the extensive application of gas turbine meters in countries where there are no gas calibration facilities present!

However, in my opinion, there have been two major exciting developments over the period in question, namely:

- a) The diagnostic capability of the ultrasonic meter has been a major advancement. The traditional meters give a reading but we have had no mechanism to tell if the reading is significant or not unless it is checked by a Prover. The Ultrasonic Meter tells us a lot about what is taking place in the pipe.

Unfortunately the operators do not always like to know that there is unaccounted for liquid in gas streams and so a meter that simply gives a number (albeit a wrong number) is sometimes preferred.

This diagnostic capability can permit the fiscal authorities to consider these meters for marginal fields where the cost and the weight of a Prover could simply be the "last straw" in deciding if a field can be developed.

- b) The rise of the Multi-Phase Meter over the years has been a fascinating exercise. We have seen, at these workshops, the meters grow from:
- fairly sketchy design concepts,
  - to experimental results,
  - to the current stage where we have operational data from the field.

Some of the extravagant claims have been shown to be false but to be fair there have not been too many over-optimistic promises.

Until we understand the physics and the physical chemistry of the multi-phase systems, I will continue to be very sceptical about the claims that 1% accuracy for flow for the different fractions can be achieved.

Incidentally as some meters popularity has waxed and waned, I believe that the decline in the usage of Provers is one of these transient phases and the use of Provers will be seen to be a necessity for accurate measurement. I venture to suggest that gas Provers will be used regularly in the next century.

## 6. YEAR 2000 AND BEYOND

At the meeting in 1982 Harald Danielsen presented a paper in which he said " In accordance with good and accepted principles of teaching, I will use 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."

He went on to show that a gas and oil system might be passing 36 Billion NOK's (i.e. approximately £3,600M) per annum. If we saved 0.1% in flow metering per station that would have been 36M NOK/annum or £3.6M.

Harald Danielsen gave me the national figure for Norway for 1997/8 of oil, gas and condensate production and this amounted to approximately 163 billion NOK (approx. £14,000M) or 38% of the total Norwegian export value. If we could save 0.1% in metering that would amount to 163 Million NOK or £14M.

This value may sound a great deal, if that is about the total annual turnover of your company or perhaps very little if you are building a new production platform.

However, if we start to talk in terms of 1% saving then we would all agree that we are talking big money i.e. 1.6 Billion NOK or £140M. Some may argue that with the current sophistication in metering in the North Sea it is impractical to expect a 1% saving. However if we have listened to papers over the years we know that there have been a number of instances where greater than 1% errors have been experienced by bad design, poor maintenance, inaccurate meters, errors in calculations etc.

Furthermore if we think in terms of multiphase and in terms of 10% uncertainty, one could argue that the oil companies and governments should make large sums of money available for research and development.

## **6.1 BEYOND 2000**

But let us stop for a moment!! Until now the paper has been based on current thinking. If we are looking into the next Century what will the Financial arrangements be?

Will it be necessary to separate the liquid/gas/solids offshore and try to measure the components in that difficult environment? Or will we simply bring the total product onshore and then separate it and measure the components? If we did that would there be the requirement for Multi-Phase Meters?

*Note: this is all a flight of fancy and not "Having a go at Multi-Phase Meters"*

Currently I understand that the purpose of offshore measurement is to give the government a value on which tax can be based, or a method of allocation to allow commingling in a pipeline - in very simplistic terms. This is the argument for the adoption of the Multi-Phase Meter.

Is it not conceivable that with all the amalgamations taking place and the adoption of a philosophy similar to that now used in the U.K. railways, where we have one operator responsible for the track, we could have one company/government responsible for bringing all the fluid ashore? The fluids would be then separated, accurate measurement of the separated fractions made and the value divided up on an agreed basis, giving a share to the developer and to the government for Tax purposes? This appears to be the basis of much of the pipeline operation at present, with the exception that just now the operators and the governments are trying to agree the financial split based on offshore metering. This then requires either separation of the fluids or the use of Multi-Phase Meters offshore.

Already we are seeing the situation where companies are offering to take responsibility for all the offshore flow measurement and simply supplying the oil and gas companies with the data they require for accountancy purposes. As the oil and gas companies continue to withdraw into their core business it can be envisaged that they will be content to rely on a sub-supplier to take total responsibility for their metering and simply give them numbers for the daily/hourly production

However, if we can foresee a situation where the fluids produced offshore are simply brought ashore and then separated then it could be argued that there was no need for meters offshore, not even Multi-Phase Meters.

I have no idea how this could be done, or even if it could be done, or even if it is already happening? It certainly would require a completely different accountancy procedure to avoid the allocation question at the very least.

## **6.2 NEW IDEAS FOR THE WORKSHOP**

The North Sea Workshop for the next 16 years must continue to provide the vision for flow measurement. To do this, the delegates need information to let them plan their metering strategy for the future. The Workshop has always had an element of training in it.

It seems to be timely for the Workshop committees to review the Workshop programme. Let us invite production engineers to the workshop to describe to the metering fraternity the options for bringing the product ashore.

Let us include the petroleum accountants and the government officials, responsible for the offshore tax regime, into the Workshop to explain the possible financial models for the future.

In addition we seem to have become too Multi-Phase and Ultrasonic Meter focussed at present. Let us broaden our scope again and include the process industry into our discussions to see the total role of the flow meter into the 21st century.

## **7. CONCLUSIONS**

7.1 The 21st century is going to be one of ever accelerating change and the flow measurement engineer must be well informed to programme the developments in flow measurement for the future.

7.2 The methodology of conducting business will change and again the engineers must keep themselves aware of the changing environment.

7.3 However, certain fundamentals of flow measurement which stay the same and must be remembered.

I suggest that these are:

- You do not get anything worthwhile for nothing and good flow measurement will continue to be costly.
- You do not get good flow measurement without very good service and maintenance
- The technology used for a particular application will depend on the available technical expertise and the local environment

7.4 Flow meters for the future will increasingly provide diagnostic capabilities as an "added value" feature.

7.5 Finally 16 years of Flow Measurement Workshops has taught me that there is something even more important than flow measurement.

It is the friends we make in this world.

I am pleased to say that thanks to the kindness of the Norwegians, the Workshop has been a place of friendship, and kindly rivalry, and I trust that this will continue to be the case this year and throughout the next century.

We trust that this will be a Workshop where we will learn a great deal and also renew old friendships and make new friends.

## 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.