NSFMW.97

North Sea FLOW Measurement Workshop

Paper ~~4~~: 1·4

ÅSGARD AND GULLFAKS SATELLITES FIELD DEVELOPMENTS

- Efficient Integretioan of Multiphase Meters -

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ÅSGARD AND GULLFAKS SATELLITES FIELD DEVELOPMENTS

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SUMMARY

Multiphase Meters are extensively being installed in two large field development projects on the Norwegian continental shelf: The Åsgard - and the Gullfaks Satellites Project.

The meters will be used for reservoir monitoring, allocation metering and well testing.

This paper presents the technical solutions, developed by Statoil as the operator and indicates the cost savings that are expected for installing the meters on the different applications.

The latest field test results are also presented.

INTRODUCTION

The large economical potential for applying multiphase meters has been the driving force behind the various development projects supported by the oil industry for the last 10-15 years. Today, several first generation meters are commercially available and the oil industry is now starting to use them in large numbers. The main areas of applications are for well testing or for production allocation metering.

The main issue the last couple of years has been to investigate the performance of various meters with respect to accuracy and operational reliability, and to find "the application envelope" with respect to flow rates, phase fractions and flow regimes relative to planned field developments. In Norway, the focus the last couple of years has furter been changed from testing of topside multiphase meters to developing and qualifying subsea multiphase meters, as well as integration of such meters with standard subsea production systems.

Added Value

The added value obtained from the use of multiphase meters is low investment cost, less maintenance cost, less production loss during well testing and better production maximation. The elimination of test line and subsea test manifolds will further reduce the investment cost in relation to subsea developments.

Using multiphase meters topside, new production/test separator for measuring and testing satellite fields can be avoided.

The maintenance cost of a multiphase meter is considerably lower than for a test separator. Using deduction testing with a test separator, some wells must be closed during the test period. This gives a loss in production capacity compared with continuous monitoring with multiphase meters.

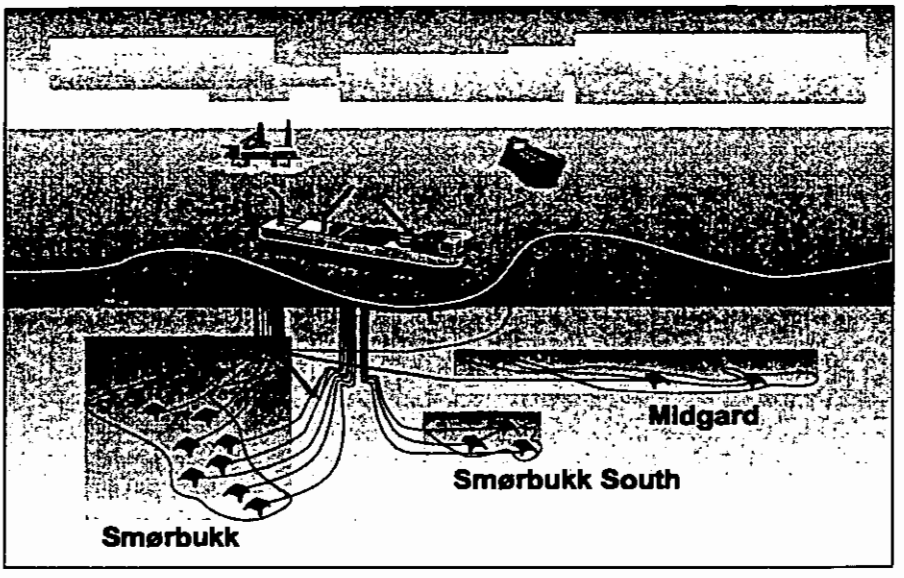
Well production can be maximised by use of multiphase meters, since gas/water breakthrough can be detected at an early stage. This is essential when producing from reservoirs with thin oil layers.

CASE HISTORY

The Åsgard Field will use subsea multiphase meters, while the Gullfaks Satellites Project will use both subsea and topside meters as a part of their development concept. It is very difficult to accurately determine the general cost saving potential from applying multiphase meters. The cost reduction will depend on many different factors, such as size of the field, the distance to the processing platform, partner and government approved allocation solution, reduced investments at the processing facilities, increased production due to better reservoir management, test separator capacity etc.

ÅSGARD

The Åsgard field complex off mid Norway comprises a FPSO vessel -Åsgard A- for the oil production and a semisubmersible platform -Åsgard B- for the gas phase. The complete field will consist of more than 60 subsea-completed wells for both production and injection. The wells are clustered on a total of 15 templates with some 300 km of seabed pipelines that will interconnect the FPSO and the semisubmersible platform with the templates.



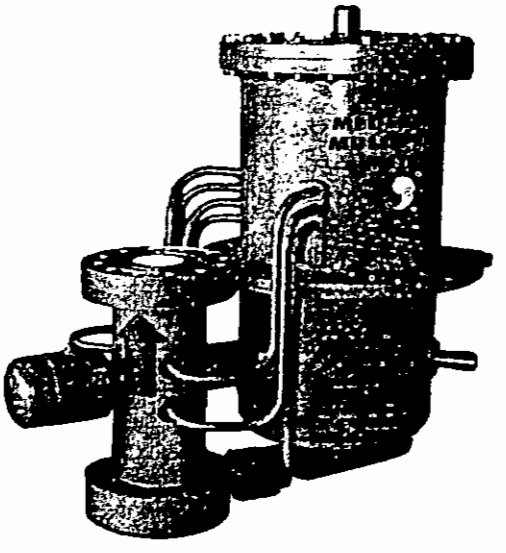
Two production flowlines will connect each template to the production units. Each template consists of four producing wells. Each of the wells can be routed to each of the two flowlines. Well testing without using multiphase meters must be done by testing one well through one flowline. This implies reduced production during the testing period due to increased pressure drop caused by three wells producing through the second flowline.

Using multiphase meters installed on each well has the following advantages:

- No production loss during well testing.
- Extended/increased production from low pressure wells due to increased availability of the test separator for production purposes.
- Immediate detection of water – or gas breakthrough.
- Improved recovery due to continuous well monitoring.

The Åsgard Project (PETEK) has calculated the added value (NPV) to be NOK 300 million by using subsea multiphase meters on each well. Based on this initiative, one subsea multiphase meter has been purchased for each production well at Smørbukk and Smørbukk South reservoirs amounting totally to 28 multiphase meters.

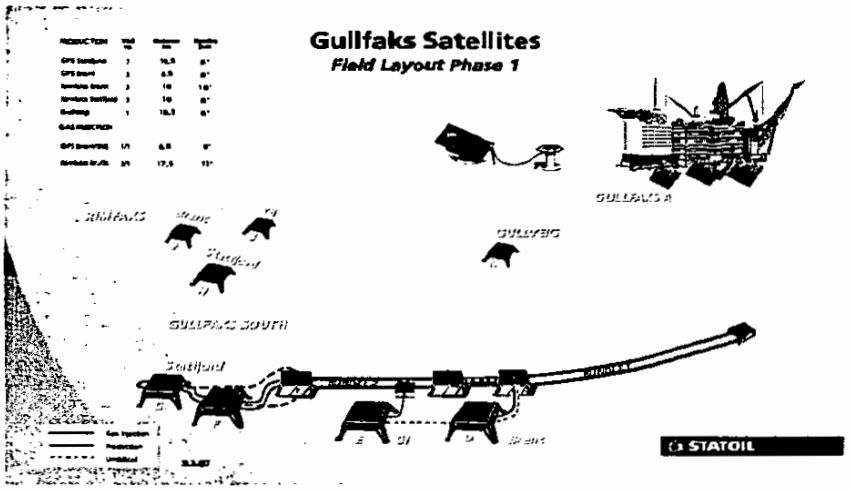
The start-up is scheduled for late 1998.



Subsea meter to be installed at the Åsgard and Gullfaks Satellite fields

THE GULLFAKS SATELLITES PROJECT

This project includes developing three different oilfields (-Gullfaks South - Rimfaks and –Gullveig-) by subsea completions tied back to an existing platform (-Gullfaks A-) for production purposes. The complete field development will consist of 8 subsea templates with a total number of 18 production wells.



The current test separator on Gullfaks A does not have the capacity to also test the Gullfaks Satellites wells in addition to the platform's existing wells. The existing wells require the test separator 20 days per month for well maintenance and test purposes. The Satellites need the test separator for deduction testing and caused by the long stabilisation period, they need access to the test separator 18 days per month. To increase the well testing capacity on the platform, two differently sized multiphase meters are installed in series with the existing test separator. These will be used for testing Gullfaks As wells. By using two differently sized meters, one has achieved an increased operating envelope to cover both large and small producing wells.

For continuous reservoir monitoring purposes of the Gullfaks Satellites, 6 multiphase meters are installed, one on each riser from the satellites.

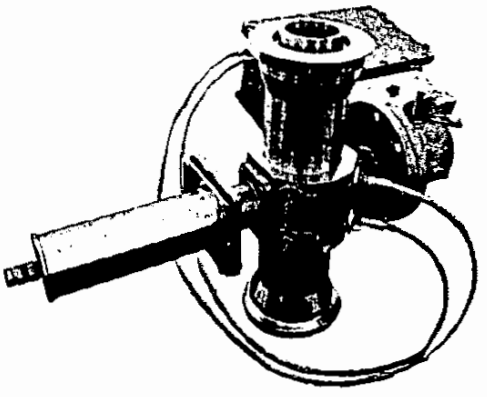
Multiphase meters eliminate the need for an extra test separator on Gullfaks A, which might cost some NOK 60 million. The cost of installation and integration of eight multiphase meters in the PCDA system is estimated at NOK 20 million. In this case, the added value (NPV) will be about NOK 40 million.

The installation of a multiphase meter instead of a test separator will most likely reduce the maintenance costs considerably each year, as an extra benefit.

The commissioning schedules for the meters on this projec are as follows:

- Gullfaks A: 2 topside meters in series with the test separator, start-up late 1997.
- Gullfaks Satellites: One topside meter on each riser, totally 6, start-up late 1998.
- Gullfaks Satellites: 2 subsea meters, start-up in1999.

In addition, Statoil considers installing subsea meters on all wells after start-up of the Gullfaks Satellites field.



Multiphase meter installed tops on Gullfaks Sat.

TEST RESULTS

Some results from a long term test of an MFI MultiPhase Meter in 1997 are presented in the following. The results are from a topside version that has been continuously in operation since 1/12-1996. During the commissioning, the meter was calibrated against the test separator on Gullfaks B. Since then the meter has been regularly tested using the same test separator.

Fig.1 confirms that the multiphase meter can handle considerable flow rate variations. The meter maintains the accuracy compared with the test separator when well B-29 was choked down (3 April).

Fig 2A shows an unusually large difference between the test separator and the multiphase meter in some tests.
The gas-oil ratio (GOR) is normally very stable for this type of well and by multiplying the test separator's oil figures with a GOR of 85, a new gas curve is created. This curve comes up very close to the figures of the multiphase meter and indicates that the test separator on Gullfaks B sometimes has problems with the gas measurements (+/- 10%)

Fig 2B and C confirm good results and long term stability compared with the test separator's oil and water measurements (+/- 2-3% repeatability)

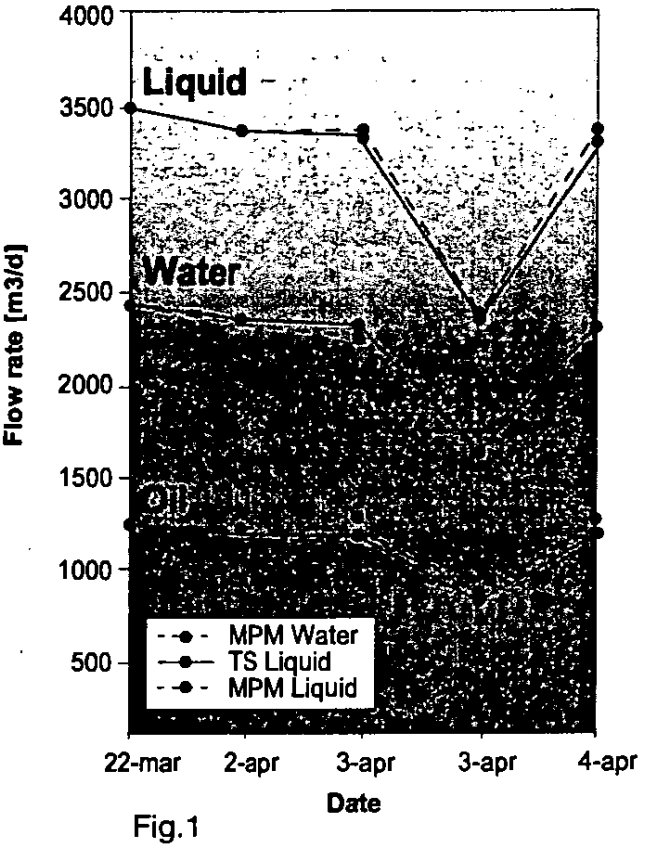


Fig.1

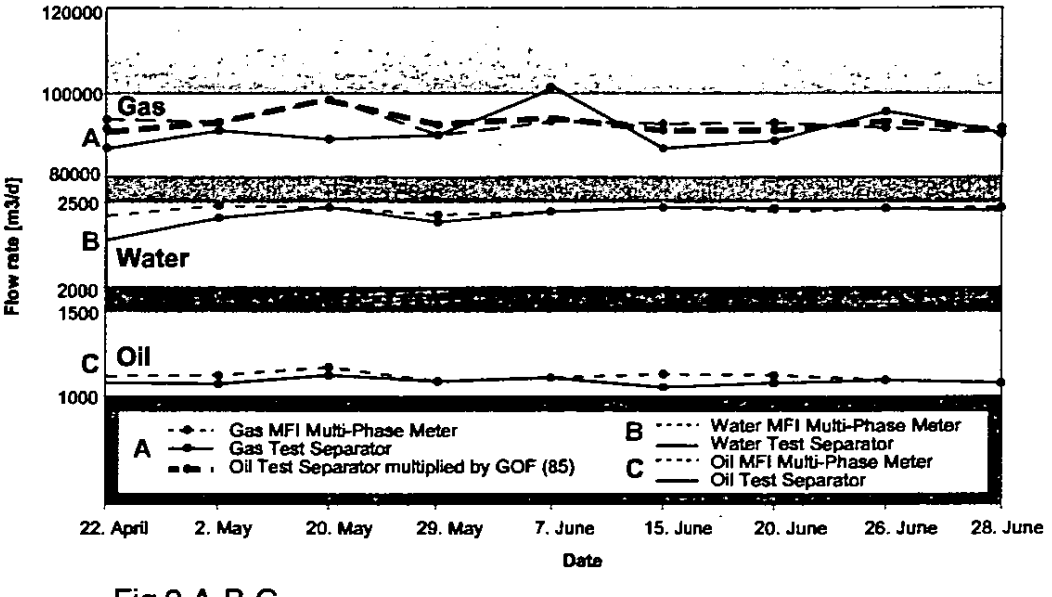


Fig.2 A-B-C

REFERENCES

- Tore Bratten & Bjørn Pedersen: `Multiphase Meters on the Gullfaks Satellite Project`. Multiphase Metering Conference 12th/13th March 1997, Aberdeen, Scotland.

- Harald B. Danielsen: 'Bakgrunn for valg av allokerings- og målingskonsept for Gullfaks Satellitter'. Norwegian Society for Oil and Gas Measurement's 'Temadag', Bergen, 21/3-1996.

- A. Mazzoni and Å. Bringsvor: 'MFI MultiPhase Meter verification at the AGIP Trecate Test Loop'. North Sea Flow Measurement Workshop 96', Peebles, Scotland.

- H.O. Hide, R. Wium: 'Subsea MultiPhase Meter'. Subsea 96' Conference, London December 96'.

- O. Økland, H. Berentsen, G. Flakstad, S.A. Kjølberg, H. Moestue: 'The Norwegian test programme for qualification of multiphase meters'. North Sea Flow Measurement Workshop 95'. Lillehammer, Norway.

- O. Økland, H. Berentsen, J. Bruun-Olsen: 'Multiphase Meters, Ready for Field Applications: Results from full scale qualification testing.' 27th Annual Offshore Technology Conference 95'. Houston, Texas.

- O. Økland, H. Berentsen: 'Using the MFI MultiPhase Meter for well testing at Gullfaks B'. North Sea Flow Measurement Workshop 94', Peebles, Scotland.