NSFMW'95

REPORT FROM

GROUP DISCUSSIONS

Lillehammer 25.10.1995

SAMPLING - SAMPLERS, ANLYSIS AND MONITORS

Chairman: Steinar Fosse

1) -It is an agreement in the group at the time now should be right for starting to us on line water oil meters. It will pay itself by saveing of labour costs.

-NEL is doing reseach work in comparing on-line water in oil meters from various vendors.

-The authorities will require comparison tests against existing sampling equipment for the first units. When confidence is established then it can be regarded as standard equipment.

2) -Sampling equipment is often wrongly designed. The equipment is often not receiving the right attention in the project phase.

-Sampling equipment is also from time to time wrongly operated. This is due to lack of proper instructions and training of the operation/maintenancee personnel.

-On-line chromatographs are normally not fiscal on the North Sea intallations.
The high uncertainty in the determination of the cost components have been regarded as and obstackle.
The aim is that new validation on projects should be launched.
The On-line gas chromatographs could then be an alternative for both colorific value (CV) and density determination.

-The authorities are waiting for a well documented application.

SELECTION OF FLOW METERING CONCEPTS I & II

Chairman: Nils Erik Hannisdal/Trond Hjorteland

-Functional specifications has to many references to international standards which lay 20-25 years behind the use of new technology.

-Projects tends to maximize on a decrease of capex and are note focusing on the opex. This focus also should be in the mind of the suppliers industry.

-New metering concept should be openly discussed with the Authority long before they become to be a realized. The Autority body, oil company and suppliers should openly discuss in an informal way as we do here on this workshop.

-The OIML - approach and the WIB organisation in the Netherlands seems to be very vital and could perhaps be a model for Norway to adopt as regards testing/qualification and verification of new technology and new concepts.

-It should be an more open communication betweeen all parties involved (oil companies, suppliers, Authorities) in custody transfer systems special, when it comes to charing test results experience.

-It should be an instrument defined to share risks/loss/profit between the oil company and the supplying industry when any project is undertaken.

-It seems to be a change in attitude as regards concervatism. North Europe is less conservative than South Europe. We are more open minded to new equipment i,e USM/U-CON etc.

ULTRASONIC GAS METERS I

Chairman: Trond Folkestad

STATUS
-Test installations / long .....tests (years)
-Lab tests
-Flare & Firegas applications
-Back-up for turbinemeters
-Allocation measurements
*Ground results from all the above activities
-PTB/NMI approval (end of year)
-Reluctancy to use the technolgy, WHY.

FUTURE APPLICATION
-Fiscal metering
-Custody transfer

USER NEEDS / TECHNOLGY "GAP"
-Noise problems from valves / regulations
    -Attepmts to use "silencers"
-Need a standard?
    -Can not wait for a standard
    -Difficult to write a commond standard.
    -Need a procedure for Authority acceptance.
-Need redundancy build into one ultrasonic meter.

ULTRASONIC GAS METERS II

Chairman: Mark Wilson

<u>Applictions</u>

Fiscal - fuel/flaregas, process flow, custody transfer including allocation

Main interest of group in gas metering. Main driving force for U/S meters still in Fiscal/Allocation. Wider rise of the technology and reporting would increase confidence and acceptance of the technology.

U/S Meters Now and the Future

Generally agreed that these are the meters of TODAY as well as of TOMORROW. The writing is on the wall for the "washer" in fiscal/allocationcustody transfer application. Accuracies getting to levels where even Turbine meters may be challenged.

Improved signal handlng etc. providing more opportunity for U/S meters with potential for Mass flow, Energy flow and with application of CFD techniques better calibration will be possible by prediction of corrections for installation effects.

VOS to look at MW, Density, Caloritic value
VOS + diagnostics - determination of liquid content in wet gas

On-going Standards Work

GRI & SWRI, ISO TC 30/WG20 - ISO Tech Report, GERG Phase 1+2, BSI standard prposals.

Percieved Major Advantages

Safety, B, Directional, Built-in Redundancy, Self Verification of status/measurement confidence.

Concerns Still Not Yet Fully Answered

No standards, noise, Installation, Proving, Lack of confidence and experience by useers/system houses/contractors - Education needed, true cost of ownership, transsducers design - effects of corrosion, liquids, blowdown, still a "blackbox"-technology, Type approval.

MULTIPHASE FLOW MEASUREMENT GROUP I

Chairman: B. Priddy

1.Operator application needs

-High GVFs/large meters worlwide
-Best accruacy (5% relative on phase) 5% or better for field allocation.
-whole life service design
-Some non-European operators learning about current capability
-Downhole measurement-future

2. Industry needs

-Agreed test/qualification methodology
-Forum activity
-Operational experience database (implies openess to share data)

3. General points

-Flexible packaging of systems to accommodate whole life service needs.

4. CALL FOR FEEDBACK

on the Norwegian Society - Handbook of Multiphase Metering from all parties world wide.

IN-SITU CALIBRATION

Chairman: Jon Eide

-Careful consideration of any timedelay in signal processing and calculations. Especially ultrasonic meters.

-Status of standarization work regarding calibration of ultrasonic meters.

-The compact prover is a accurate and reliable tool in order to carry out in-situ calibration.

-Calibration by raioactive tracers is probably a method with holds a potential in the years to come, espesially for allocation metering.

-There may be a possible demand for portable gas meter provers.

MULTIPHASE METERING II

Chairman: Chris Wolff
Attendance: 13 users, 2 consultants, 15 suppliers.

1. How to specify user requirements and meter performance.
- Before entering into the discussion reference was made to both the handbook of multiphase metering (NFOGM report nr. 1, 1995) and the paper by Slijkerman et-al. presented by Jamieson on 25.10. 95.
A clear point of contention emerged: many users can not determine whether a meter is suitable for their application from the way test results are presented usually ie.an error US oilrate or GVF or any other parameter. The multidimentional character of the performance requires that one present operation envelopes, both in the two phase map and GVF watercut map.
A minor point was whether the twophase map should be lineair (as in the handbook) or logaritmic. This was not resolved.

-Other point discussed were: the representativeness of loop tests for the real world: The need for high pressure high flow rate test loop(s).

2. The multiphase meter marked

-There are 30 000 to 40 000 wells drilled each year, only 50 or 100 subsea. The first multiphase meter installations are likely to serve typically 10 wells via a test manifold. Hence the initial annual marked is never bigger than 3000 to 4000 , or 5 to 10 subsea per year.

At surface the price has to be low compared to a test separator to be attractive , ie. much smaller than 0,5 Million $. Subsea the potential savings are bigger then the meter may cost more. However when considering a multiphase meter the key question at this moment is about performance, which is often considered not adequate yet. The price issue comes only after the performance.

3. Wet cas / gas condensate measurement.

-Options considered were:
a) venturi measurement only, but with wetness correciton or
b) venturi plus gamma ray measurement. Some vendors claim that they can demonstrate good performance with option b). Not every one was convinced of that yet. This has to be followed up.

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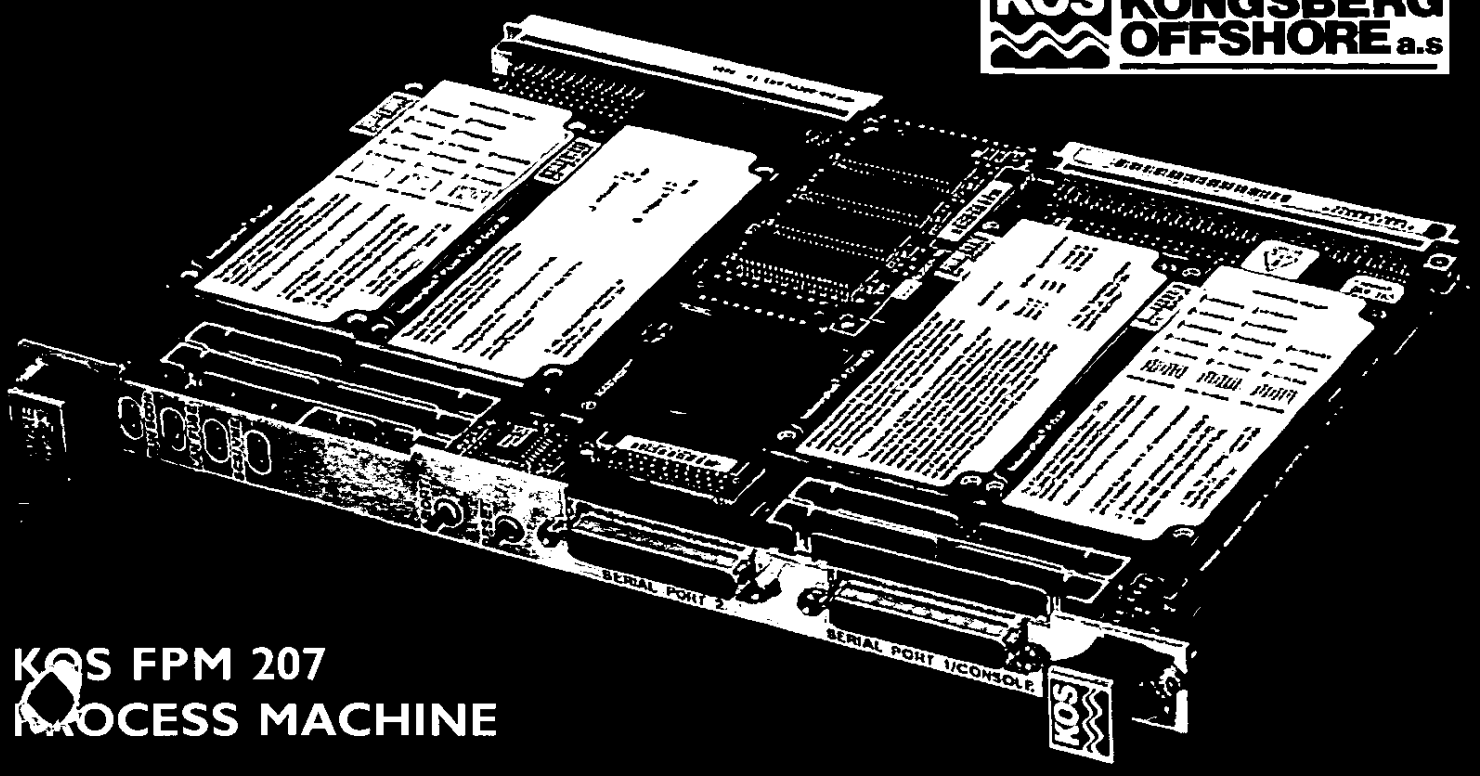

KOS FPM 207
PROCESS MACHINE

KOS FPM 207 is a new generation process machine incorporating the functionality of a high end flow computer for both liquid and gas metering, as well as a prover controller and a programmable logic controller. Each of these functionalities have been implemented with no compromise on quality or sophistication. The choice of the latest technology industry standard hardware platform ensures a safe and reliable upgrade path and removes the risk associated with in-house development of proprietary hardware. The software implements all calculations and algorithms required to achieve maximum metering accuracy, and meets or exceeds user requirements as regards operation and maintenance. The structure of the software provides a solid, well tested foundation for implementation of user-specified functionality or future developments of metering calculations and algorithms.

SPECIFICATIONS

HARDWARE

Processor board
Motorola MVME 162 with MC68040 32bit CPU with integral Floating Point Unit. Capable of taking up to 4MB RAM, 1 MB Flash, and 512k SRAM.

I/O
IndustryPack intelligent I/O modules:
- Digital IP with 16 optocoupled inputs and 16 outputs.
- Analogue IP with 4 outputs and 8 inputs, 12 bit + sign.
- Serial IP with 8 RS232 channels, capable of smart communication by means of RS232/HART signal converters.
- Counter IP with 3 frequency inputs, 2 dual channel or 4 single channel turbine meter inputs, and 4 interrupt inputs for detector switches. Contains a high stability time base with temperature stability better than ±5ppm.

Network
IEEE 802.3 network (Ethernet) between process machines and with the supervisory system.

SOFTWARE

Operating system
Microware OS9 real-time operating system.

Programming
- ANSI C compiler is used for generating executing code.
- PC tool for user configuration of database, as option.
- IEC 1131-3 compliant PLC programming language for sequence and logic control, as option.

Database
Object based data structure held in SRAM.

Communications
- TCP/IP based communication between process machines and with the supervisory system.
- Modbus protocol for communication with external devices.
- HART protocol for communication with smart transmitters.
- RS232 / VT100 for communication with portable PC.

GENERAL DESCRIPTION

KOS FPM 207 consists of a single processor board housing the central processor unit with support circuitry, conventional memory, battery supported memory and read-only memory. The processor board can take up to 4 piggyback I/O modules which allows for almost any combination of input and output by plugging in the appropriate modules.
In a system configuration the individual process machines communicate on a network with each other and with the supervisory system. Each processor maintains an object database containing both process values, calculated results, parameters and configuration data. This data is held in SRAM and will not be lost during power failure.
Program code and metering constants are held in Flash-EPROM and cannot be altered by the user.

USER INTERFACE

In a multistream configuration the user interface will normally be provided by the supervisory system. For maintenance and local operation the process machine provides a user configurable menu-based man-machine interface running on a laptop computer or other VT100 compatible terminal. Each processor board is connected to an individual control panel. The basic configuration of the control panel includes a line maintenance key switch, a common alarm LED, and a heartbeat LED controlled by the watchdog function.
Options include counters for flow totals and pulse errors, and a display / keypad for local operation and indication.

INSTRUMENT INTERFACE

Input and output signals are handled by the I/O modules based on the IndustryPack standard, called IP modules. In the standard configuration a process machine is fitted with:

- one IP module for digital I/O,
- one for analogue I/O,
- one for serial/smart communication,
- and one for frequency measurements, pulse counting and detector switch signals.

Communication with analogue transmitters is based on the Rosemount HART protocol. To preserve full accuracy the communication is in fully digital mode. When required, the process machine may be fitted with a different I/O configuration, choosing from the wide selection of IP modules available.

GENERAL FUNCTIONALITY

KOS FPM 207 can handle up to 3 metering streams in any combination of gas and liquid streams. The configuration is controlled by the database whereas the software is unchanged. KOS FPM 207 can operate both as a Client and as a Server in a network of process machines or networked with external systems. This Open Systems design ensures good scalability and integration capabilities and provides a safe environment for implementation of application software.
The software structure is modular and operates in a multitasking environment centered around a common database. The database contains all configuration data, process data, results and parameters. I/O scanners, communication routines, man-machine interface and fiscal algorithms, all interact with the common database through a well defined Application Programming Interface.
Checksum verification of both program code and metering data is performed at regular intervals to ensure integrity of vital software and data.

LIQUID FUNCTIONALITY

KOS FPM 207 incorporates the functionality required for both a stand-alone flow computer, a prover controller and a process machine operating in a tightly integrated system network. It is equally suited for both continuos metering as well as batch metering.
The following features are included:

- Flow calculations to API, IP and ISO standards.
- Turbine meter dual pulse train handling to ISO 6551, Level A, error detection and correction.
- 4 sphere detector switches read for each proving trial with recording of accurate time and pulse count for each. Detector switch diagnostics performed.
- Pulse interpolation to ISO 7278/3, dual chronometry.
- Proving sequence control for both bi-directional, controlled launch and free launch, unidirectional, and compact provers.
- Single K-factor as standard, 10 point K-factor curve with parallel curve correction, as an option.
- Densitometer handling, common or per stream.
- Temperature measurement compensation in accordance with IEC751 equations, optionally based on calibration certificate data.

Batch metering functionality includes batch start, hold, stop, recirculation mode, non-resettable totals, retroactive meter factor. Pump control, back pressure control as well as loading arms control is optionally provided.

GAS FUNCTIONALITY

KOS FPM 207 can operate both as a stand-alone gas flow computer and in a multistream system configuration.
The following features are included:

- Flow calculations to API, ISO and AGA standards.
- Flow calculation based on differential producers is performed in accordance with ISO 5167.
- Turbine meter calculations according to AGA7, ISO/DIS 9951.
- Ultrasonic transit time meter handling.
- Densitometer handling with three Velocity of Sound correction equations.
- Density and compressibility calculations according to AGA 8, GERG88.
- Calorific value calculations in accordance with AGA5, ISO 6976.

The time base for flow totalisation is derived from a high stability oscillator. The frequency can be measured externally for verification purposes. Measured frequency can then be entered into the database and the offset will be automatically compensated for in software.

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