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FIELD EXPERIENCES WITH ULTRASONIC FLARE GAS METER AT THE STATPIPE GAS TERMINAL, KÅRSTØ AND AT THE GULLFAKS-B PLATFORM IN THE NORTH SEA.

BY

SVEIN LOUIS BERSAAS
TRANSPORT DIVISION
STATOIL A/S
KÅRSTØ, NORWAY

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Why ultrasonic flare gas meter at the Statpipe Gas Terminal?

Problem:

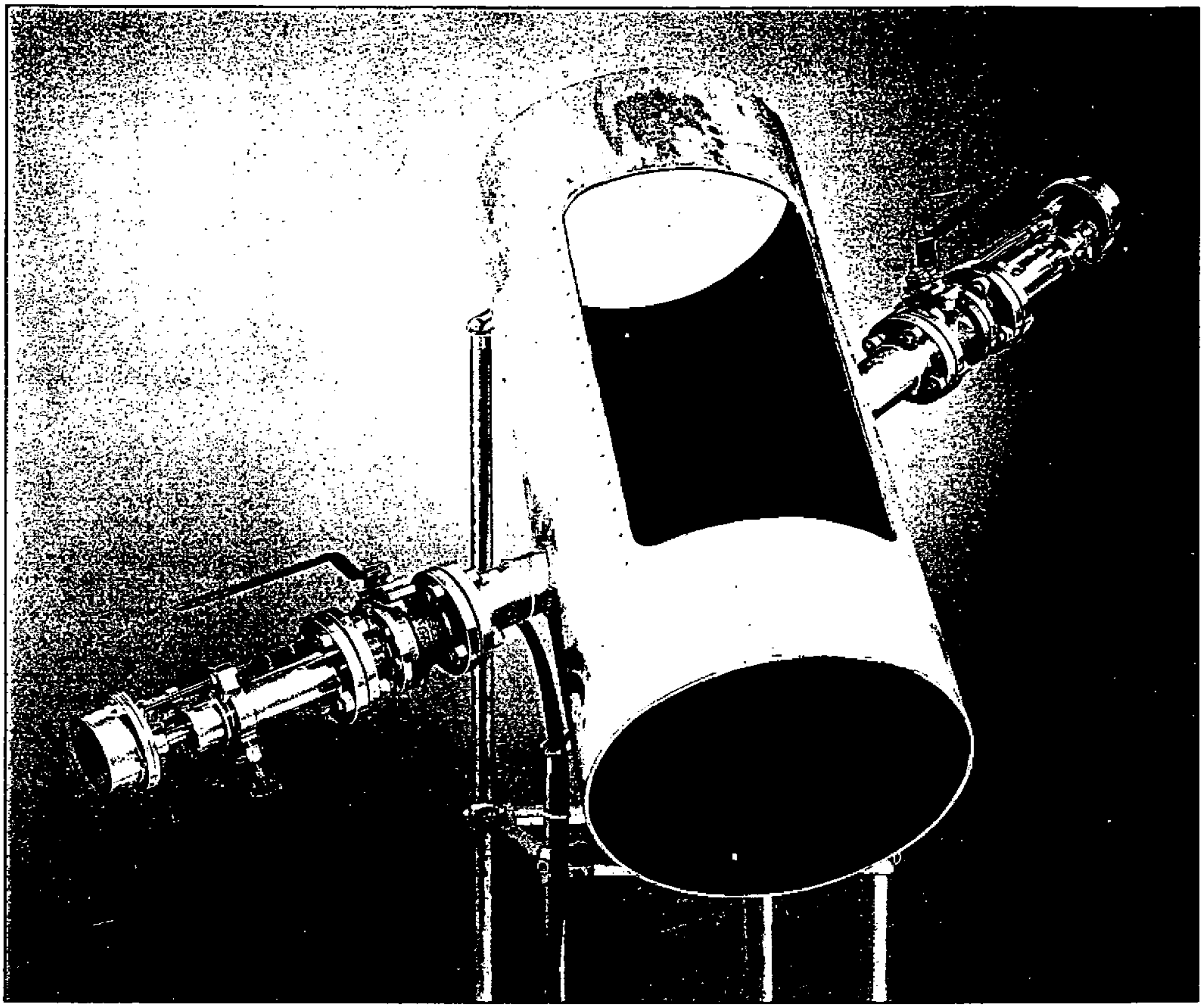
The existing annubar flowmeter with the calculated range of 30.000 - 640.000 Kg/h did not satisfied the necessary range of 200 to 250.000 KG/h as "normal" flaring.

Solution.

The ultrasonic flare gas meter FGM 100 satisfied the required low and middle range 200 - 250.000 Kg/h

The annubar meter will still measure the upper part of the range.

The expected low maintenance cost is also an advantage.



The Fluenta FGM 100 flare gas meter measures volume flowrate and mass flowrate in flare pipes

The Fluenta FGM 100 flare gas meter has been designed to solve difficult measuring problems in flare gas pipes, with low pressure, a wide range of velocities and large pipe diameters.
The FGM 100 Flare gas meter uses the transit time to measure the flare gas velocity. Two specially designed transducers are mounted non-intrusively in the pipe wall. Each transducer transmits and receives ultrasonic pulses, and the electronic system measures the time the pulse needs to travel from one transducer to the other. An unique technique is used to recognise the pulses and measure the transit time.
With a gas flow in the pipe, the pulse travelling against the flow will need longer pulse travelling with the flow. This time difference is used to find the gas velocity, and to calculate the volume flow in the flare gas pipe.
The signals are repeated 100 times per second. The measurements are averaged every two or four seconds, to give a steady meter reading and output.
For the system to be able to give readings in standard cubic meters (Sm^3), signals for temperature and pressure must be given to the flow computer. These signals combined with information about estimated sound velocity are also used in calculation of the gravity of the gas.

FLUENTA

Installation

Fluenta A/S has transducer-mounting jigs for several pipe diameters. Transducer adaptors are welded to the pipe at precise angles for optimal pulse transmission.

References

The FGM 100 has been developed by the Chr. Michelsen Institute in Bergen, Norway and the project was sponsored by Mobil and Statoil. It has been installed on platforms in the North Sea as well as on a petrochemical plant. Extensive testing at the Gullfaks B has shown a much better accuracy than the one

Fluenta FGM 100 technical specifications

General

Mains supply:	220 V AC/110 V AC 50/60 Hz
Power consumption:	50 VA max.
Pipe sizes:	8" dia. min., 72" dia max.
Velocity range:	0.05 – 70 m/s for 72" dia. pipe 0.05 – 100 m/s for 36" dia. pipe 0.20 – 100 m/s for 8" dia. pipe
Uncertainty at 95% confidence level:	5% of measured value at fully developed turbulent flow conditions.
Resolution:	Velocity: 0.01 m/s for 36" dia. pipe
Repeatability:	Better than 1% of volume flow (with velocity from 0.3 – 100 m/s).
Calibration:	0.3 – 70 m/s with fully developed turbulent flow profile.

Flow computer

	Flow computer and signal processor mounted in 19" rack with power supplies.
Input:	Velocity: Signal from transducer via optical fibre cable Temperature: 4-20mA Pressure: 4-20mA Specific gravity: 4-20mA
Output:	Recorder: 0 – 10 V DC (4-20mA optional) Ch. 1: Volume flowrate low Ch. 2: Volume flowrate high Ch. 3: Volume outputs optional Counter: 24 V DC pulse for electro-mechanical counter. Resolution: 50 standard cubic meters for total volume.

Front panel

Mounted in 19" rack, with:
16-character alphanumeric LED display and 29-key data entry/function keyboard.
2-channel recorder (3-ch. optional).
8-digit electro-mechanical counter.

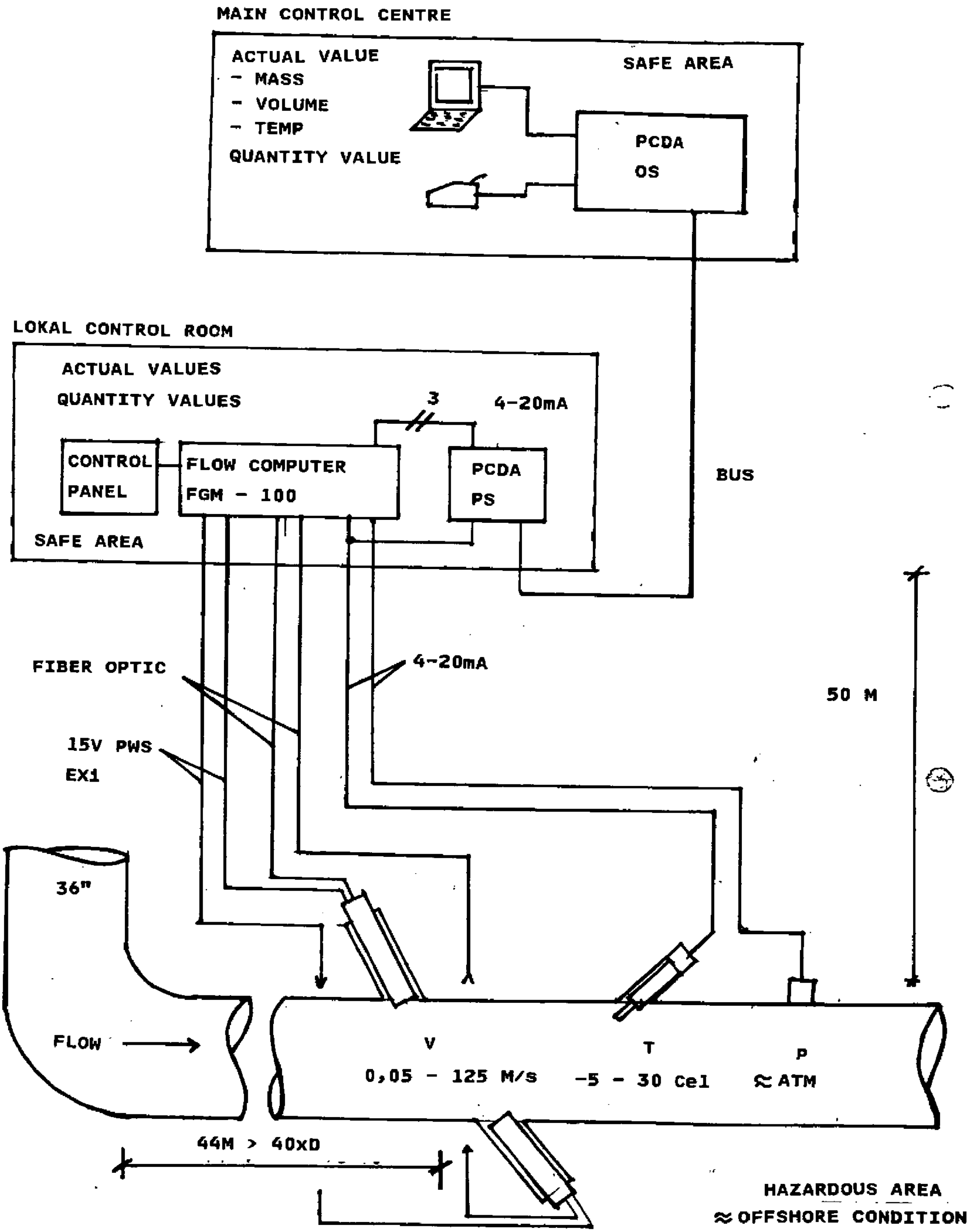
Display functions:	
Volume flowrate	(Sm3/hr)
Total volume	(Sm3 x resolution)
Mass flowrate	(kg/hr)
Total mass	(kg)
Temeprature	(Centigrade)
Pressure	(bar)
Specific gravity	
Velocity	(m/s)

Ultrasonic transducers

Operating temperature: -10 – + 75 deg.C
Pressure: 0.8 bara – 5.0 bara
Weight: Each 9,6 kg excl. valve and socket.
Dimensions: Lenght 0.70 m (transducer unit).
Signal transmission via optical fibre cable.
Electrical safety: Intrinsically safe with certified power supply and cable.
Safety class: EEx ia IIC T6
BASEEFA approval, cert. no. Ex 86B2411
Ex 872089

For further information, please contact: Fluenta A/S, P.O. Box 162, Fanaveien 13, N-5051 Nesttun, Bergen, Norway. Tel. + 47 5 13 75 10 • Telefax + 47 5 13 68 78

SYSTEM CONFIGURATION ULTRASONIC FLARE GAS METER
STATPIPE GAS TERMINAL, KÅRSTØ



Experiences from the installation at the Statpipe Gas Terminal.

* The angle of tilt between the transducers are critical. The welding work of then the necessary pipe stubs were therefore performed with highest accuracy.
  Even when using a welding jig this caused some problems because of the heating up and the following drawing when cooling.

* The welding was performed when the plant was shut down and inerted flare system.

* The necesarry holes were drilled by using "hot tapping" technics performed by specialists.
  The special angles gave firstly no specially problems.
  By using dummy transducers the bore and the angles were tested to be in order.
  But later the operating showed something else.

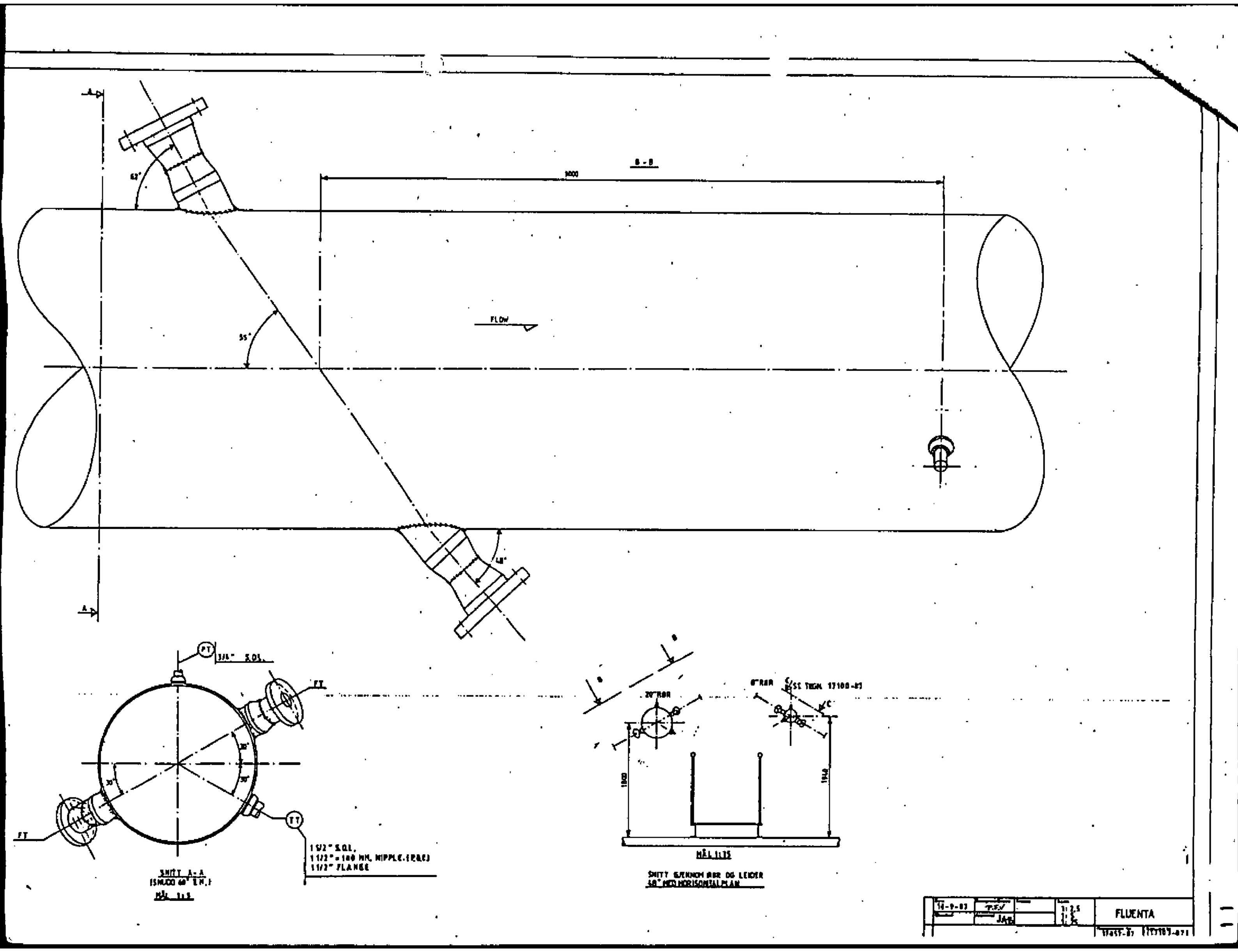
* Due to the mechanical problems a "spool piece" is recommended.

* Because of the high velocities care must be taken regarding the lenght (resonance) of the necessary thermowell.
  For this purposes a special thermowell was made where the critical point were moved.

* The termination of the fiberoptic for signal transmission need accurate work.
  Care must be taken to the higher minimum bending radius compared to ordinary signal cables.

* The insertion of the transducers gave some problems because of the small diameter difference (2 mm) between the transducers and the bore, also that the drill have deviated from the central axis caused by the angle.
  The whole arrangement included the ball valve were then moved a litle bit to get "correct" position for insertion.

* The other components like the flow computer etc. gave no problems including the interface to the PCDA.


B - B
FLOW
PT
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1 1/2" S.O.L.
11/2" FLANGE
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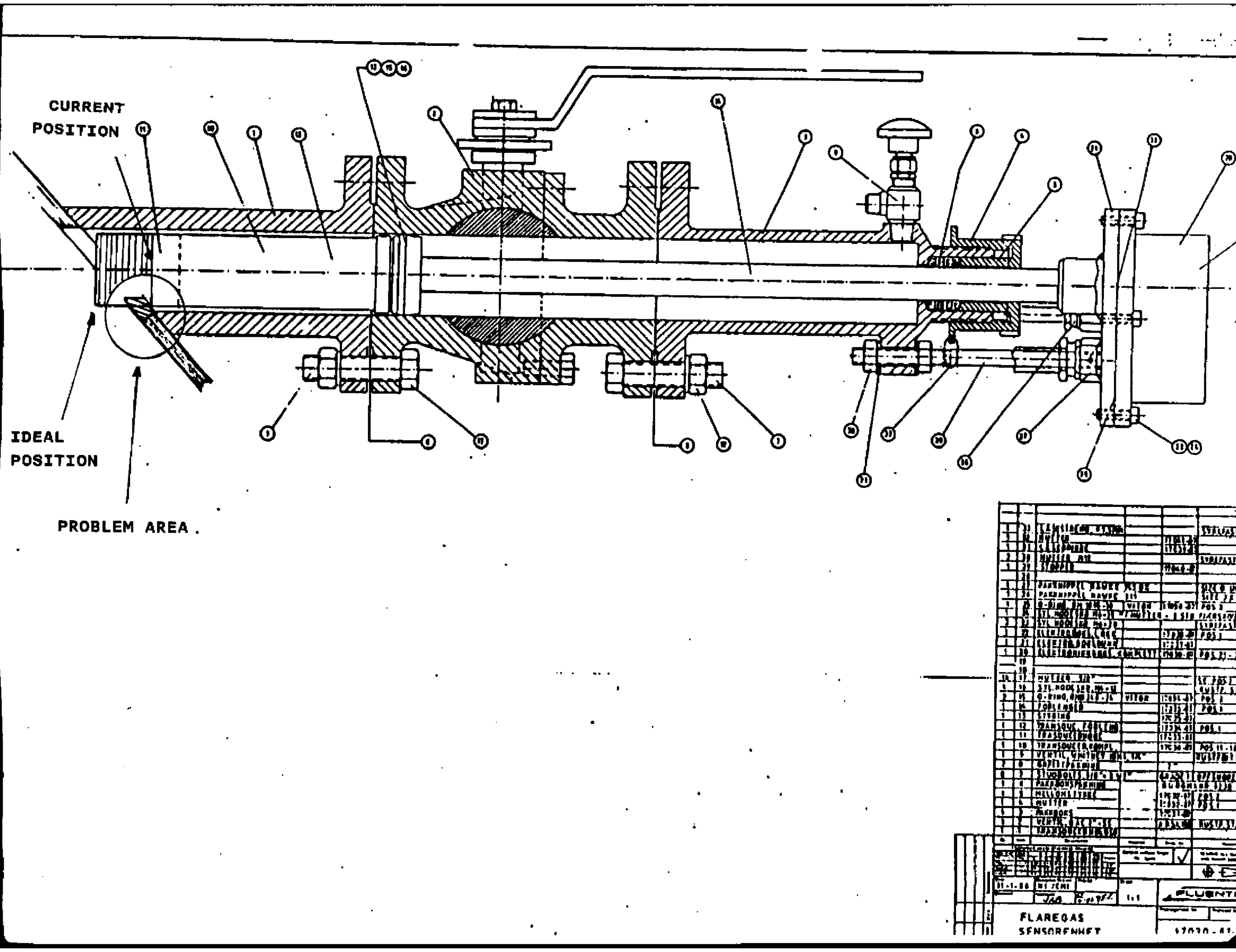
CURRENT POSITION
IDEAL POSITION
PROBLEM AREA.
FLAREGAS
SENSORENHET

Experience from operating at the Statpipe Gas Terminal

* The flare gas meter was partly installed june -88 while an uppgraded version (interface to the PCDA etc.) was installed in january -89.

* No systematically test have been performed yet, due to the fact that there was no good comperable references specially in the lower range.
  For the lower range referance is made to tests at Gullfaks-B plattform.
  For the upper range (>50.000 Kg/h) test is prepared to an annubar meter where the curve display function in the PCDA will be used for logging (30 days.)

* The meter and the measurement is only "tested" by comparing to assumed values.
  This result seemes to be acceptabel.
  The meter is expected to show either real values or rubbish.

* Flow velocities was early measured in the range 0 (-4) to 130 m/s.
  By use of oscilloscope the unstable zero/minus flow seemed to be caused by turbolence or noice/damping in the signal caused by incorrect position or angle.

* One of the transducer failed in des -88 caused by an deffect solenoid.
  A new transducer was made and inserted with the same problems about position.
  Therefore the transducer was positioned outside the pipewall which then caused very high damping of the signal (lobe) with unstable (minus velocity) measurements as a result.

* The several experiments conclude with that the bore must be drilled up again but with a diameter of 52 mm.
  Thereafter the planed test can continue.

* By using the "velocity of sound" the meter is capable to measure the density of the gas in the flare.
For one sample the analyse at the laboratory resulted in a density of 0.69 kg/m3 while the meter indicate 0.77 kg/m3 where T = 29.0 degC, P = 0.993 BARA

Experiences from operating at the Gullfaks-B platform in the North Sea.

* The same type of instrument FGM 100 but for 8" and 20" flare, were installed in the early spring -88. Different short and long term test have been performed in the lower range 0 - 20.000 Sm3/h.

* In short term test a deviation of < 1% to a testseparator (orifice based) in the range 20.000 Sm3/h have been measured.

* Comparasion to a heat loss flow sensing element for a short term test resulted in a deviation of about 30 % in a range where the ultrasonic was "correct". The heat loss flow sensing element measured to low.

* In long term test good correlation of +-1% of metered production has been obtained.

Conclusion:

The ultrasonic flare gas meter has shown by observations and tests at the Statpipe Gas Terminal and at the Gullfaks-B platform the necessary quality for satisfactory and realibility flare gas metering.

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.