Main Index

NSFMW.97

North Sea FLOW Measurement Workshop

Paper ~~9~~: 2.3

FLOW METERING CONCEPTS, AN ENGINEERING CONTRACTORS EXPERIENCE

Authors:
Lars Brunborg and Dag Daler, Kværner Oil & Gas as, Norway

Organiser:
Norwegian Society of Chartered Engineers
Norwegian Society for Oil and Gas Measurement
Co-organiser:
National Engineering Laboratory, UK

FLOW METERING CONCEPTS, AN ENGINEERING CONTRACTORS EXPERIENCE

by
Lars Brunborg
Kværner Oil & Gas as, Norway

and
Dag Daler
Kværner Oil & Gas as , Norway

FLOW METERING CONCEPTS, AN ENGINEERING CONTRACTORS EXPERIENCE

Lars Brunborg and Dag Daler, Kværner Oil & Gas as, Norway

SUMMARY

We will give a brief discussion of an engineering company's experience regarding fiscal measurement systems. This will be seen in relationship to the use of NORSOK standards, versus functional and detailed specifications, and simplified and cost efficient concepts.

The constrains on the design is also commented on, and the influence of these constraints on layout, maintainability and operability.

Further a brief review of the computer concepts available, including integration with DCS

Finally we will review the relationships between Supplier - Engineering Contractor - Operator, seen in relationship to integrated teams, frame agreements, etc.

INTRODUCTION

Kværner Engineering, now an integral part of Kværner Oil & Gas as, has an extensive experience in the design and construction of oil production facilities and platforms, including fiscal metering systems, from the early 1970'ies and up to today. The company has been involved, over the years, in the changes from EP contracts with detailed specifications and detailed inquiries through to EPCI contracts with functional specifications and frame agreements, based on NORSOK.

NORSOK STANDARD VERSUS FUNCTIONAL SPEC

Detailed specifications.

Establishing specifications has always been one of the problems at the start of a new project.
As the specifications included a great deal of details, they are normally a time consuming activity. It is also often difficult to copy information from earlier projects due to the inherent differences between the oil companies, and various requirements within their operational groups.
Detailed specifications are also placing hard constraints on the suppliers who quite often had to follow a new standard on every project. This practice has also often resulted in budget growth and planning difficulties for the supplier resulting in delayed deliveries and/or uncompleted deliveries with a number of punch items to be rectified at site.

On the other, hand it made life easier for the engineering companies and the commissioning teams, because specified requirements were available during punch out of the equipment. This furthers the standardisation of equipment and solutions for the users, but not for the suppliers, and thus leads to a higher price level. (One would normally expect the suppliers to deliver at lower prices if they can use their own standard specifications.)

Functional specifications.

Functional specifications were the first step towards cutting expenses. As they do not contain as much detailed information they are less time-consuming to write and the engineering effort decreases. As the level of details goes down, the problems around acceptance of the delivered items increase. The engineering and commissioning teams' doe not have the same number of "detailed data" to use when checking the equipment. This will inevitably lead to controversy with the supplier, as several items will depend on the preferred solutions by one or the other of the individuals involved.

NORSOK

NORSOK is the last step in this trend, where the industry wants to standardise and cut expenses. It furthers standardisation on a "higher" level, outside the oil companies. It also makes it easier for the suppliers to get their own standard specifications accepted, as long as they conform to what is laid down in the NORSOK standards. The supplier standard therefore becomes acceptable to a large number of end users.
One can say that NORSOK bridges the gap between the detailed and the functional specifications. Quite a few of the details from the detailed specifications are agreed between several end users and laid down in NORSOK. The engineering companies can then use their time to get the best functionality for the system. At the same time there is an agreed set of details to use during checking of the equipment, and approval of the delivery.

NEW CONCEPTS

Ultrasonic meters.

What sort of new concepts are we looking for today? The ultrasonic fiscal gas meter is finally on the way into the marked, but we are still waiting for the full impact of the ultrasonic fiscal liquid meter. The technical aspects behind these meters will be dealt with in details in other presentations, and is not a topic of this presentation. We are looking forward to further developments around these meters.

Prover concepts

The standard bi-directional prover has been used in all projects KoG AS has been involved in since Oseberg A. The compact prover installed on this skid has later been removed.
A compact prover was discussed on the EKOII project but was rejected due to size restraint. A vertical compact prover was too high.

As the prover is a heavy and large part of an oilskid, the suppliers should do their utmost to revert with more compact designs. Possibly looking into solutions where the prover becomes redundant. - One such solution would be a liquid ultrasonic meter where a spare, calibrated meter, was available on the platform ready to be installed.

Oil companies unwillingness to try, due to NPD reluctance

New measuring principles are not apearing every day, and when something as the ultrasonic flowmeter appears, there is always a great interest in the industry for these new "components". Everyone would like to test it, but in the end there is a great reluctance to tray out something where the field experience is limited, or none existing.

Well proven technology is a good thing, but more willing to try new techniques are missing.

We are looking for the oil companies to start discussions with NPD at an early stage, to clear the way for new ideas.

More openness for new concepts

The metering industry as a total, but especially the oil companies, should be more open for trying new concepts. With this we do not only mean new components as the ultrasonic meter, but also new ways of utilising these and the existing measuring concepts. We feel that it should be possibly to introduce new "concepts" if discussions are started, for example with NPD, at an early stage, and the oil company has done its homework properly.
An example of this, are the discussions started by one of Statoil 's metering experts, with NPD, regarding the Sleipner T gas measurement. This was an allocation metering station in a 20" line, based on a senior orifice fitting, the fiscal measurement being done on the SLA platform. He presented a case where he showed that the total uncertainty over a long period was unneglible if a 1x100% meter run with a bypass was used instead of 2x100 %. This was based on the assumption that the flow during the short time the bypass was open was taken as the average of the flow the last minute before the bypass was opened. The bypass was only used during inspections of the orifice. This concept has later also been used for fuel gas measurements.

CONSTRAINTS ON DESIGN

Size, weight (available envelope very small - standards for "guesstimate" during preengineering)

One of the major problems during the preengineering phase of a development project is to estimate the size and the weight of the equipment to be installed. This also includes the metering system(s), as these are of a significant size. This was originally done as pure guess work by layout engineers, based on the size and weight of the system from an earlier project, with approximately the same flow as the one being "sized. This could also be based on very preliminary input from the suppliers. More common was to take the available space and us it. In the end, this normally resulted in a small envelope. Further, a small envelope results in a "crowded" design (i.e. narrow accesses ways, bad accessibility to components, etc.), from the supplier.

We feel the suppliers should involve themselves in this area and help to develop these thoughts into sizing guidelines for preengineering.

To reach as optimum an envelope as possible, it should, in our opinion, be possible to start with an existing skid and "resize" this to new dimensions. If we try to analyse this situation, we should be possible to single out some important factors that govern the change of size, as for instance:

- The number of the metering runs. This will determine the width of the skid if this was the only item being changed. It could then be argued that the width of a meter run is a factor of the diameter plus access, which would be of the order of 1m assuming access only from one side
- The meter run dimension. This would influence both the width and the length of the skid, the latter due to the influence on the straight length (number of D's)
- Flow. This will decide the number and size of the meter runs.

From these reflections it should be possible to resize a skid, after the flow per meter run has been established.

This should be a fairly straight forward exercise for a gas skid, where the length is easily increased in proportion to the size. The width can easily be treated similar. Similarly increasing the headers proportional to the meter runs.

For a oil/condensate skid this becomes more complicated as the prover must be taken into consideration. One could assume that the prover size should be extrapolated as for the meter runs, and the prover located below or on the outside of the skid. Similar assumptions should be made for a compact prover.

If one assumes a certain weight split between the baseframe, meter runs, and the prover, it should also be possible to scale the weight.

Following this line of thought will not give an exact weight, and size envelope, but it should improve the "estimate". It should also enable the suppliers to produce better and more user friendly skid layouts during the detailed engineering phase.

Skid layout (stairs, ladders, functionality, serviceability, etc.)

The problem with skid layout, as discussed above, resulted very often in a "crowded" design, and has been a challenge to the suppliers, even if this has improved over the years. This has mainly been a problem with oil metering skids, as the gas metering layout is less complicated and more a function of the constraints given by international standards.

In our experience there is certain problems that are more common than others, by listing them we hope not to meet these items as often in the future as we have in the past:

- Good access between meter runs
- Avoid pipes/instruments, etc. intruding into the access area.
- Make sure all items to be read or accessed can be read/reached from the access way on the skid, not from the outside.
- Make sure that lager pieces of equipment, for example valves can be removed for maintenance.
- Do not forget the instrument enclosures in the design (if applicable)
- Make sure stairs and ladders are according to regulations and standards.
- Make sure the heights of doors to GC houses, etc. are according to regulations and standards

COMPUTER CONCEPTS

Main computer (single, dual, PCS node)

A hot standby dual main computer system was the standard some years back, as this system fulfilled the Norwegian regulations. When the regulation was modernised, an opening was given for using only 1 main computer system. This has led to 3 trends, regarding main computer systems:

1. Dual main computer system
   This has been the traditional system over the years and is still used by oil companies, but it is also the most complicated one, both hardware and software wise. This is mainly due to the hot-standby layout with hardware connection for switching between the computers. It is also the most expensive since two complete computer systems are involved

2. Single
   This has been used by some oil companies since it is a simpler and cheaper system. Its main drawbacks are the availability, as there is no permanent back-up, and the main computer system will be down, during breakdown, until spare parts have been brought from the platform spare stores.

3. use of platform control system (PCS) node
   It has been common in the last years for the main metering computer system to communicate with the platform control and monitoring systems via a datalink or network connection. Since the state of the art for hardware platforms for metering main computer system often, is the same as for the platform control and monitoring systems, a natural step is then to combine the metering supervisory computer system with a PCS node. As this in reality is a "single" system, it has the same drawback. It's main advantages is the hardware functionality and that the operation of the metering system, for the operator, is similar to the rest of the system

Traditionally, in solution 1 and 2 above the main metering computer has been the full responsibility of the metering computer system supplier. In solution 3, on the other hand, two different concepts emerges:

1. The Metering system supplier purchases, or are free issued, a PCS node, and uses this as the hardware for the supervisory computer system, with full responsibility as in 1 and 2 above.

2. The metering system supplier supplies a functional description covering the supervisory metering computer system functionality, including the communication with the flowcomputers. The DCS supplier must then use this to program the DCS node. This solution has, so far, been used on the Åsgard A platform, and will be used on Åsgard B.

Flowcomputer (dedicated units versus standard computers)

Two trends has been seen the last years regarding the subject of flowcomputers.

Most suppliers use dedicated units, with 1 flowcomputer for each metering run. The alternative has been to program the flowcomputer functions standard computer system.

What are the pros and cons for these two alternatives:

- Dedicated units
  Normally cheaper, 1 per metering run
  Easily programmable from front of unit (or PC)
  Application software in PROMs, can easily be updated.
  Easily replaceable with new unit from spares.
  Requires less space in cabinet

- Standard computer
  More expensive, this must be compensated by programming two flowcomputers for two different metering stations into the unit.
  Replaced with cards from stock.
  More elaborate programming tools (and equipment) needed.

Taken these items into consideration our opinion is that the dedicated flowcomputer is the more cost effective and flexible solution in the long run.

SUPPLIERS

Number of available suppliers.

The bidders list for metering systems are established very early in the projects, in the pre-engineering or basic engineering phases. To get a good competitive situation it is important to have a sufficient number of bidders. For most instrument packages this has been in the order of 4 to 5. The use of too many bidders creates to much work during the evaluation stage, and to many suppliers have to put down a substantial number of hours without getting anything back. Experience has shown that 3 is an optimum number, one get a good competitive situation, and the amount of work involved in the evaluation is acceptable.

This is ideal for the metering situation in the Norwegian sector, as there is only 3 suppliers normally capable of delivering complete metering skids/systems.

Taking the number off project over the years into account, our experience is that this is in line with the work available. We are thus certain that we will have at least 3 competitors fighting for every project in the years to come.

Frame agreements - long term agreements between suppliers and oil companies.

Then on to frame agreements, which binds an end user or a contractor to a supplier for a period over several years. A positive side of this is that the contact between supplier and end user is very close. This can result in early involvement by the supplier giving optimum designs, as the design is done in close co-operation, and not in a bid situation.

We have seen that the competitiveness of the suppliers changes all the time with respect to prices, delivery times, etc.. During one period one supplier delivers the best bid, whiles in other periods' one of the others have most success.

This might lead to the unfortunate situation that one supplier wins several frame agreements during the same period, whilst the rest are short of work. A dangerous outcome of such a situation is that the number of suppliers decreases, with the result this would have on the competitive situation in the marked.

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.