Challenges in the Flow Measurement Engineering Study Phases

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Summary:

Offshore development of marginal Oil and Gas fields can often be economically profitable if they can be tied in to existing platforms. This usually requires execution of comprehensive feasibility studies, which can often be a long and costly process. Close cooperation in a multi-discipline engineering team is necessary to assure that all possibilities and aspects of the design task have been evaluated.

Integration of a new flow measurement module on an existing installation is often the simplest solution, yielding low total cost as the module can be assembled and fully tested on shore. However on many installations one is required to integrate the new equipment in existing modules.

Flow measurement is a crucial element in the development of marginal fields which has to be evaluated, taking into consideration all critical aspects such as: available space, weight, location accessibility, maintenance and integration to existing metering systems. In particular, special attention should be given to the possible use of new flow measurement technologies and principles.

1. INTRODUCTION

For the past 35 years the North Sea has been populated by a number of types of platforms and rigs, essential for the development of offshore oil and gas fields. This rough environment has largely contributed to technology process developments including fiscal and flow measurement.

During this period Aker Kværner has been at the front End in MMO (Maintenance Modification Offshore) and has acted as an Engineering Contractor involved in most Norwegian fields development.

Aker Kværner is pleased to share their experiences in the accomplishment of those integrations study challenges to keep installation and study cost to a lower level.

2. ENGINEERING CONTRACTOR

What kind of role does Aker Kværner play in this relationship?

Aker Kværner is well acquainted with national and international standards as well as the requirements of most oil and gas related companies operating in the North Sea.
Aker Kværner has a good overview over the metering equipment available on the market.
Aker Kværner is a multi-discipline profession company. The most important disciplines regarding the metering design are process layout, installation, telecommunications, safety and instrumentation. These factors enable Aker Kværner to come up with the most optimal metering solutions.
Aker Kværner does not manufacture any metering equipment, but cooperates closely with suppliers to acquire the optimal solution for the customer.

3. STUDY PHASES

As an engineering contractor Aker Kværner is involved in different phases of the engineering process. The study is classified in 5 phases. Each phase is not necessarily performed by the same company. The study can give a basic cost evaluation with recognised levels of accuracy.

- Idea studies – no specific requirement.

- Feasibility study – cost estimate within ± 40 %.
  The technical work in this phase should focus on new and modified equipment in systems that obviously will be affected by the actual design requirements.

- Concept study – cost estimate within ± 30 %.
  The objective of the concept phase is to select and define the modification concept for realising a business opportunity, implement HSE requirements or reduce operational expense, and demonstrate that execution risk is satisfactory to the company requirements and business plans.

- Pre-engineering – cost estimate within ± 20 %.
  The technical documentation to be further matured defining basis for project execution (detail engineering and construction).

- Detail engineering

To achieve the required level of accuracy the disciplines involved must be well coordinated. When starting to evaluate conceptual design; there is not always enough information available to develop an accurate budget for a relevant metering system. It is however essential that the requirements can be established at the earliest possible stage, to provide a clear perspective for the project team. Consequently, a study period is required to look at different solutions. The project needs to reach a more mature state. Relevant data for the requirement specification are production profiles, process conditions, field life and required standard of metering.
Many new developments are often small satellite fields. These need to be installed within the boundaries of the existing field infrastructure, utilizing an existing plant. This can create a challenge for existing metering systems that may need to be upgraded in order to bring the metering up to the required standard. To make marginal developments economically viable, metering is often less than full fiscal standards to reduce cost.

4. OFFSHORE SURVEY

Offshore Survey is a very important part of the engineering and is performed for the different study phases as it can give an absolute value to the study. Meeting with offshore personal is normally arranged prior to arrival on board; description and reason for the survey are given to the flow metering technician who will act as co-ordinator for other offshore disciplines.

In the case of integration of new metering equipments many aspects should be reviewed which might involve different engineering disciplines such: Instrument, Electrical, Piping, Structural, Process, Safety, and Maintenance etc. It could be necessary for different specialists to be part of the survey as documentation may not always been updated. Generally it is always beneficial for the project that engineering is familiar with the platform and can establish direct contact with offshore personal.

During survey all technical aspects should be reviewed in order to assess all possible alternatives such:

- Computer hardware & software, upgrading
- Structural , supporting
- Piping , tie-in possibility
- Maintenance, accessibility to equipment
- Location, installation possibilities
- Shut Down requirement
- Prefabrication work including all alternatives
- Utilities requirements
- Hot work necessity
- Temporary equipment, cable etc
- Safety escape route etc ,
- Demolition
- Down time
- Standby spare parts

Offshore survey should be considered as a major requirement to assure successful project performance.

5. ENGINEERING TOOLS

The engineering Contractor main challenge for the project is to assure that all phases will be accomplished in time and within the cost estimation. The flow metering installation will usually depend on shut down activity requiring a constant follow-up for engineering activities, vendor deliveries and test prior to installation.
To accomplish these tasks Aker Kværner use several interconnected tools.
For the detail engineering and vendor follow up the main tools used are:

- PEM (Project Execution Model)
- PDMS / 3D CAD (Plan Design Management System) / (3 Dimensional Computer Assisted Drawing)
- T IME (Technical Information Management Environment)
- MIPS (Material Integrated Production System)
- ELECTRONIC SURVEYING

For the concept study and pre-engineering, a useful tool that is used:

- Meter Run Dimension, Weight and capacity.

5.1 **PEM**

The Modification Task part of the Aker Kværner Project Execution Model for M&M defines the following main phases:

The main intention with PEM is to ensure a consistent development of activities with inter discipline dependencies. These activities are controlled through defined level of completion requirements towards defined milestones.

A set of Execution & Management Key Deliverables are defined and for each Key Deliverable a quality level chain is established with check lists defining the content of the information for each quality level. Each quality level shall be achieved within a certain milestone (ref. Fig. “Execution Key Deliverables” & Management Key Deliverables”).
Typical Execution Key Deliverables with established checklists are:
Study Report
Procurement; Supplier documents & drawings (SDD)
System Engineering; P&IDs
Engineering Register
3D Model /Layout
Installation method

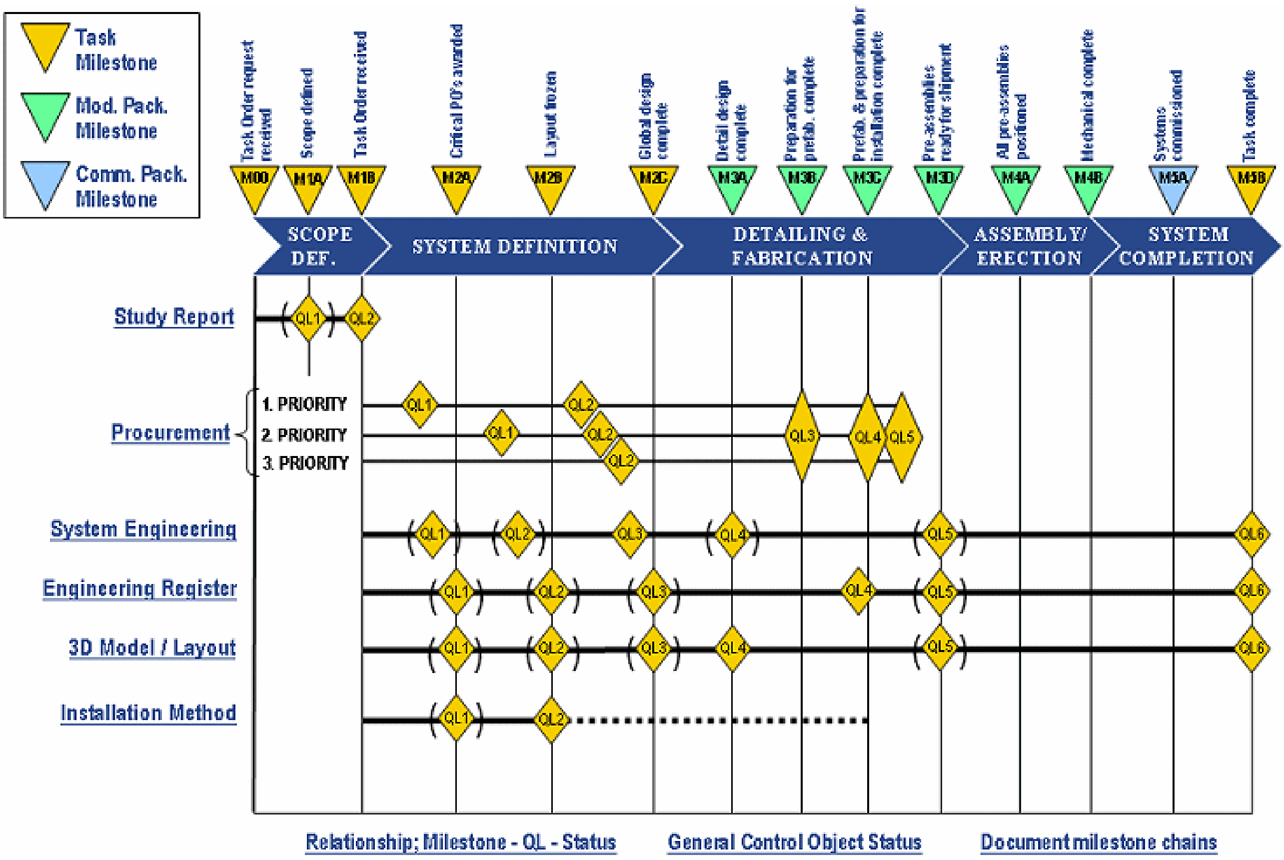


Fig.: 5.1 A "Execution Key Deliverables"

5.2 PDMS (3D CAD)

PDMS is a fully integrated 3D multi-discipline design environment for Piping, Structural, Electrical (cable tray), HVAC, Mechanical, Instrument and Safety. PDMS consists of the following main modules:

- Catalogues and Specifications
- Design (all disciplines)
- Draft (Drawing production from the 3D model, all disciplines)
- Isodraft (Isometric Drawing Production, Piping/Electrical/HVAC)
- Clasher (Clash Detection system, Interactive or Batch)
- Reporter (Various Model and Material reports as object Status, CoG, BOM etc.)

Associated with the 3D model is the walk-through system "Review Reality" which provides an excellent means of design verification and hands-on feeling of how the design will work in practice.
To minimise duplication of data, and to avoid data inconsistency, SQL is used to integrate and link data in the 3D model with data stored in other database systems used by the project (i.e. MIPS & TIME).

5.3 **TIME**

TIME is a multidiscipline engineering application used as standard by all disciplines to track changes to technical information. TIME is use for planning, control and follow-up of the production environment and there are five distinct modules.

TIME Activity for all engineering and procurement related work defined as engineering and procurement activities.

- TIME **Document Plan** is the network activities for the project, deliveries from these activities are defined as input to fabrication-, installation- and commissioning. References to engineering, procurement, fabrication, installation and commissioning activities can be established for all the deliverables.

- TIME Document Control manage all deliverables in the project, Expedites issues for IDC and comments, mark-up and revisions in the fabrication and installation phases, Engineering Numbering System, DFO (documentation for operation) activities etc….

- TIME Document Expediting, manage all supplier documentation, delivery plan, document numbering, distribution for discipline review, and expedite document delivery plan etc…

- TIME Engineering Register for all tags, cables and lines. Line sizing and electrical load list management etc. It provides electronic checklists for 3D modelling and document/drawing production. Linked to CADView 3D review, and to Tektonisk datasheets. TIME is linked to fabrication and commissioning application Sireko MIPS

5.4 MIPS

MIPS is a multidiscipline- and “total construction and material management”- system, designed to follow up all kinds of projects within the Contractor’s organisation.
MIPS covers all phases of the Contractor EPCI execution model from start of system engineering to hand over of a tested and installed product to the client.

All information necessary for the total construction and material administration will be gathered in one common database accessed by the Sireko MIPS, which makes sure that each information element only has one occurrence.

Main output formats are: Material requisitions, Purchase orders, Material tracking reports, progress reports as activity charts / histograms, work orders with details, mechanical completion check sheets and certificates, preservation status and commissioning certificates.

5.4 ELECTRONIC SURVEYING

Over the last ten years Aker Kværner has been using electronic surveying and this has proved to be a success. Significant investments in surveying equipment has been made and Aker Kværner presently employs approximately 20 surveyors.

There are several advantages by using electronic surveying. This is relevant for the integration of metering skid into a module contributing to reduce hot work offshore and reduced installation man hours.

We obtain documentation of what is measured into a 3D-model within an accuracy of 3 mm

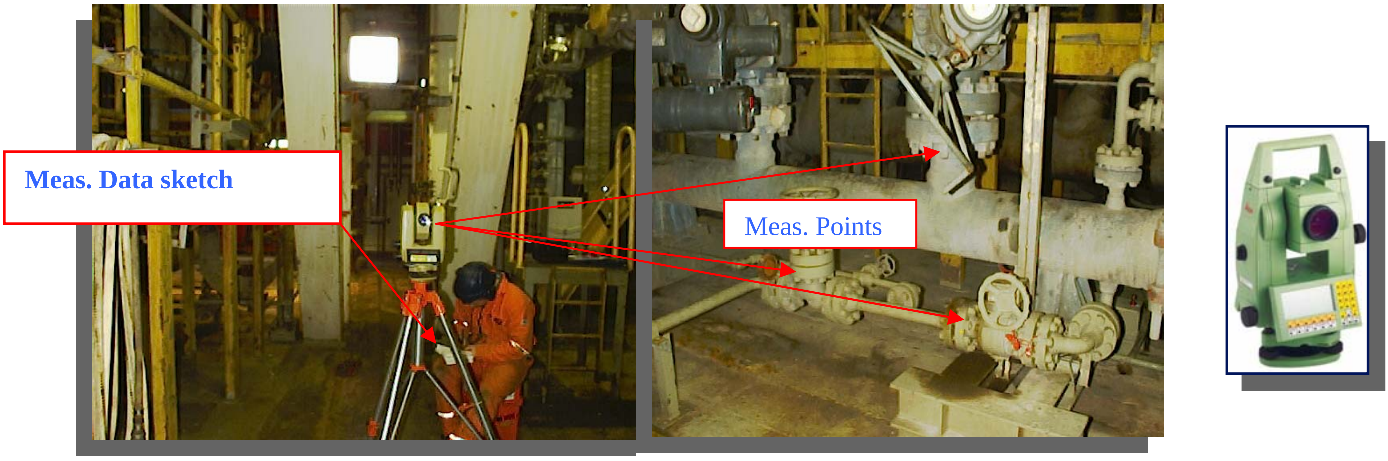


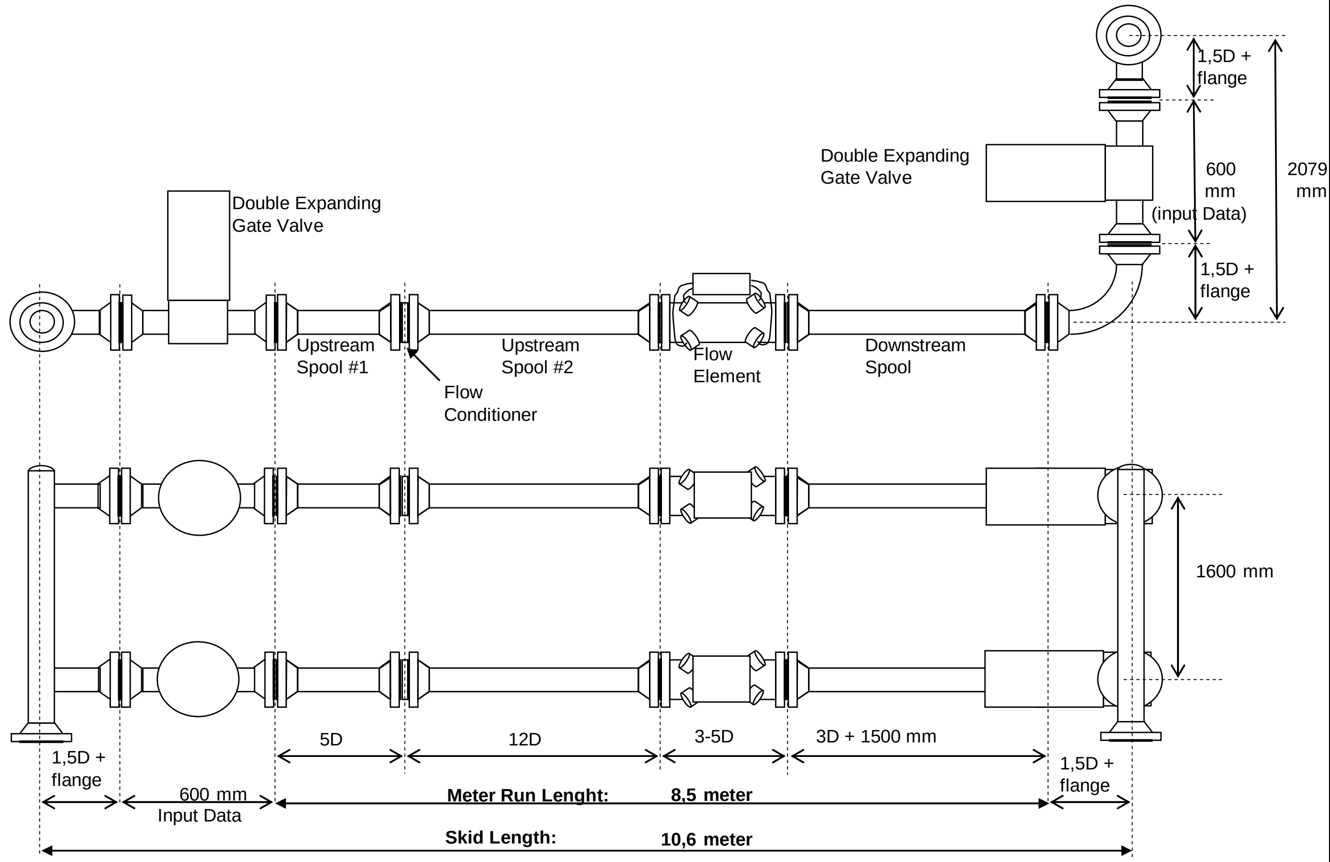
Fig.: 5.4 A / Typical offshore electronic surveying.

5.5 WEIGHT/SPACE ESTIMATION

This is an Excel tool developed by Aker Kværner and is related to USM gas fiscal metering skids as shown on the sketch See fig 5.5A. By inputting pipe & valve data, total skid weight and dimensions are resolved for this typical layout. It gives a prompt answer for the study group during Concept and Pre-engineering study phases.

The accuracy expected is good, weight and dimensions are determined for skid equipped with double expanding gate valves for upstream & downstream manifolds. Results are to be adjusted if other valves are used or if manifolds are different.

Meter Run Dimension, Weight and Capacity



Input Pipe Data	
Pipe OD (mm):	323,85
Wall Thickness (mm):	10,00
Nominal Pipe Size:	12"
Pipe Class:	1500#

Input Valve Data	
Face to Face (mm):	600
Weight incl. act.(Kg):	500,0

Meter Run Weight Details	
Flow Element:	1204,0
Pipe:	464,0
Flanges & Flow Cond:	2191,0
Branches & Field Instr:	400,0
Total Weight Meter Run:	**4259,0**

Other Weight Details	
Valves 4 ea.	2000,0
Bends 2 ea. (4 flanges & 2 bends)	1367,0
Headers 2 ea. 6 flanges & 4 m pipe	2193,5

Dimension Details	
Lenght of bend and flange (mm)	739

Calculated Data		
Meter Run Length:	8,5	m
Meter Run Weight:	4259	Kg
Skid length	10,6	m
Skid height	2,1	m
Skid width	1,6	m
Skid Weight	18302	Kg

Capacity:	**min**	**max**
m/s	1	15
actual m3/h	261	3916

Fig. 5.5A / Weight Dimension Tool Lay out

6. NEW TECHNOLOGY

New technology needs to be proven in test loop in order to gain an insight into product performances. It is well recognised that test loops will never reflect actual field conditions even if the product has been tested extensively.

One of the principle major standard requirements for the engineering contractor for equipments to be delivered and installed are:"Only proven instrumentation / equipment should be used". This is mainly to assure that products taken into operation have been fully tested and well proven; in summary:" No prototype can be used which can jeopardise the project".

Despite this restriction; within offshore oil and gas field development, in the North Sea and elsewhere, Oil Companies and Manufacturers have contributed largely to the development and promotion of new products, via pilot project.

Those products based on new technical solutions have very often as main objectives to reduce installation cost, to cover a wide range of process production with high accuracy, to have a low maintenance cost (OPEX), a high availability (Long lifetime reliability), a low cost (CAPEX) and a weight and space savings. Those factors can directly very often contribute to the project feasibility or viability.

New products can be classified into two distinct entities"Main Products" and"Sub Products (auxiliary)". Main products are related to flow measurement, and sub products for auxiliary equipment: such as valves, filters, density transmitter etc

For the flow measurement in the Norwegian sector, Norsok Standard I-104 Chapter # 4-1 states:

General Rule

"The measurement system which fulfils the functional and technical requirements and has the lowest life cycle cost shall be selected".

6.1 Main Products

In the past 15 years products such as: USM, MFM, water in oil meter, oil in water meter, gas chromatograph etc have been subject to extensive development, with many interesting papers issued at different workshops providing new Standards and Guidelines to all parties involved in flow metering. Those products have contributed largely for satellite fields to be developed and most particularly for marginal fields. Recently new products for wet gas measurement have been made which are still subject to intensive field testing and look to be very promising in the near future.
Coriolis Mass Flow Meters used in process control has started to be used as fiscal measurement on the Norwegian sector where it was introduced on the Draugen platform by Shell and taken into operation in the summer of 2000. The Shell Draugen gas export project was challenged with several issues such as: gas and condensate in the same metering station, small volumes of gas and condensate , less maintenance, space, weight and cost. After a study involving several vendors the solution to use coriolis meter looked to be an optimum.

This was encouraged by PSA (Petroleum Safety Authority) following a concept study involving Aker Kværner. A paper was issued two years ago under the 21 st workshop in 2003 “Experiences with a Fiscal Metering System using Coriolis Meter” and concluded that the Coriolis meter was proven to be suitable for fiscal purposes.

It is just amazing to think that a 200 years old discovery made by Gaspard-Gustave De Coriolis born in 1792 today forms the basis for maybe one of the most important measurement principles employed in world of industrial metrology and process control.
Due to the Coriolis meters compact design, which gives space reduction and reduced weight, it compares favourably with traditional flow measurement and is certainly a beneficial meter for integration on existing platform.
The shell Draugen fiscal meters for gas and condensate consisted of five Micromotion Coriolis as shown on the Fig. 6.1-A, composed of, one meter (stream 1) for the liquid, one meter (stream 2) for alternatively gas/liquid, two meters (stream 3 & 4) for gas and one check meter acting as a master meter.
Prior to meter principle qualification for this application one meter (1, 5”) was tested extensively at K-Lab (Kårstø) for gas and Con-Tech Services A/S (Stavanger) for liquid.
Due to the Coriolis measuring principle the meter do not require the traditional upstream / downstream straightening lines and can be easily integrated on a skid. The fig. 6.1-B shows the Draugen overall skid dimension (Two parts for installation).

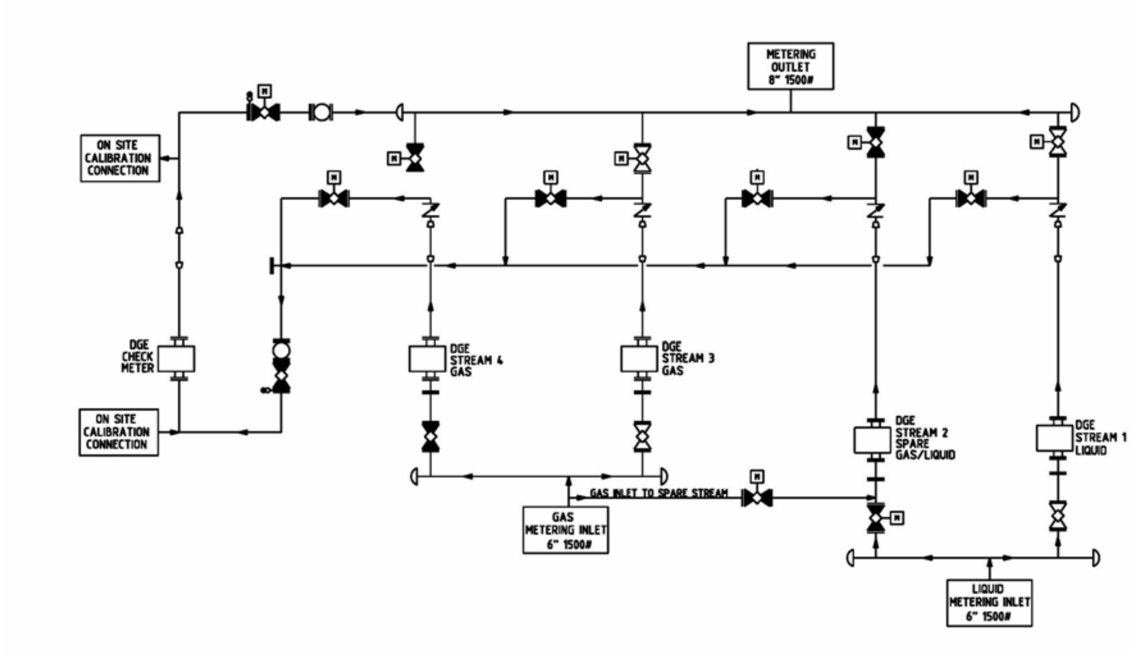
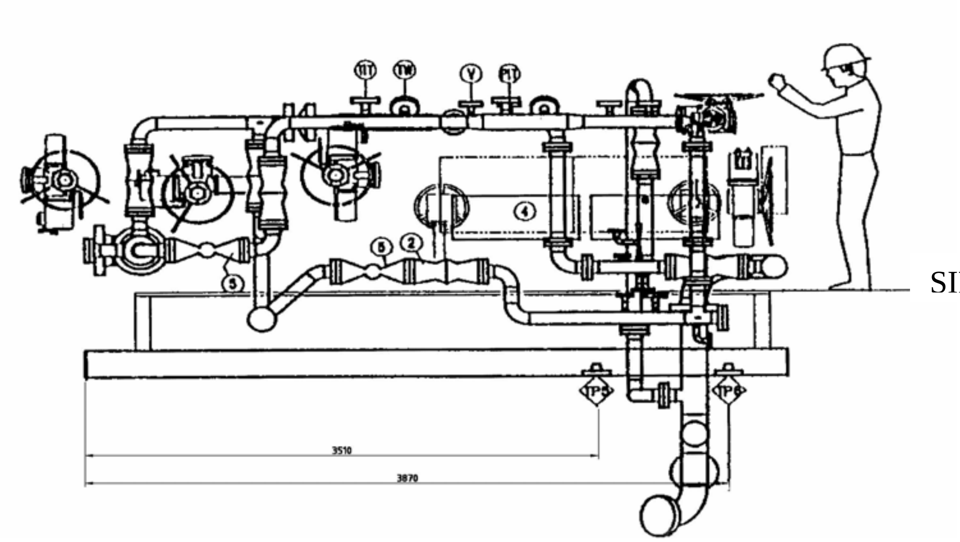
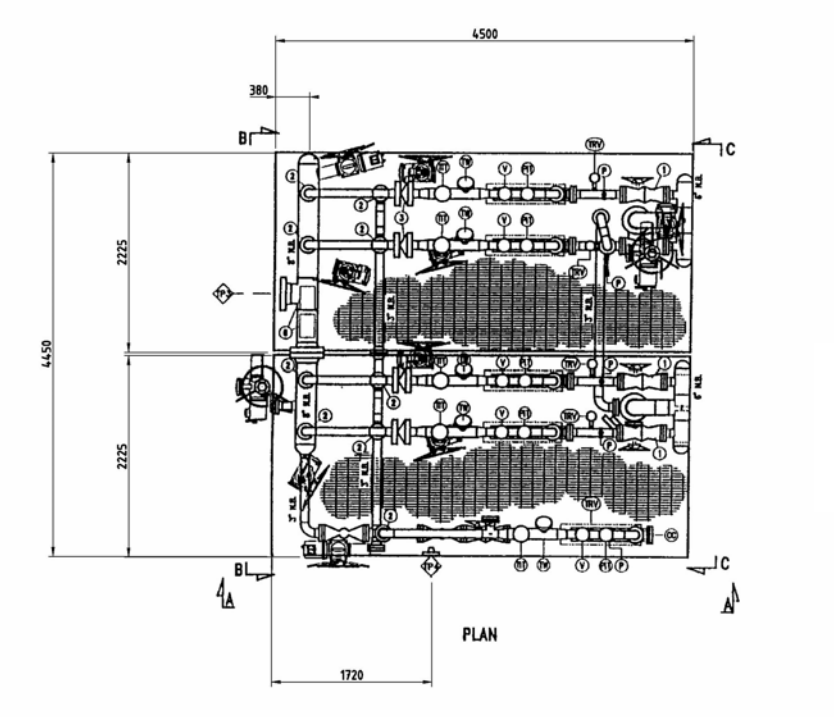


Fig: 6.1.A / Draugen Shell Coriolis fiscal meters Flow Diagram



SIDE VIEW A-A



6.1.B / Draugen Shell Coriolis fiscal meters skid for Gas & Condensate mounted in two parts.

6.2 **Sub Products**

Metering sub-equipment classified as new product should not be under estimated. As example we can mention some specific items reviewed by Aker Kværner during Projects for Statoil. This concerns one Double Block & Bleed valve for USM transducer (DB&B), one transducer calibration chamber for the Draupner platform and one wet gas sampling panel for the Sleipner platform.

6.2.1 **Daupner Platform**

The Draupner S and E platforms in the North Sea form a key hub in Norway's network of submarine gas pipelines, with pressure, volume and quality monitoring of gas flows as their most important functions. Draupner S was installed in 1984 as part of the Statpipe system.
It tied the Statpipe lines from Heimdal and Kårstø together for onward transmission of dry gas to Ekofisk. The first gas flowed through the platform in April 1985. Draupner E was installed in 1994 as part of the Europipe I gas trunk line system from the Sleipner fields to Emden in Germany. With seven risers measuring 28 to 42 inches in diameter and associated manifolds, these installations occupy an important place in Norway's gas transport system to continental Europe. The fig. 6.2.1 A shown the Draupner flow diagram with this 12 USM and two GCs.

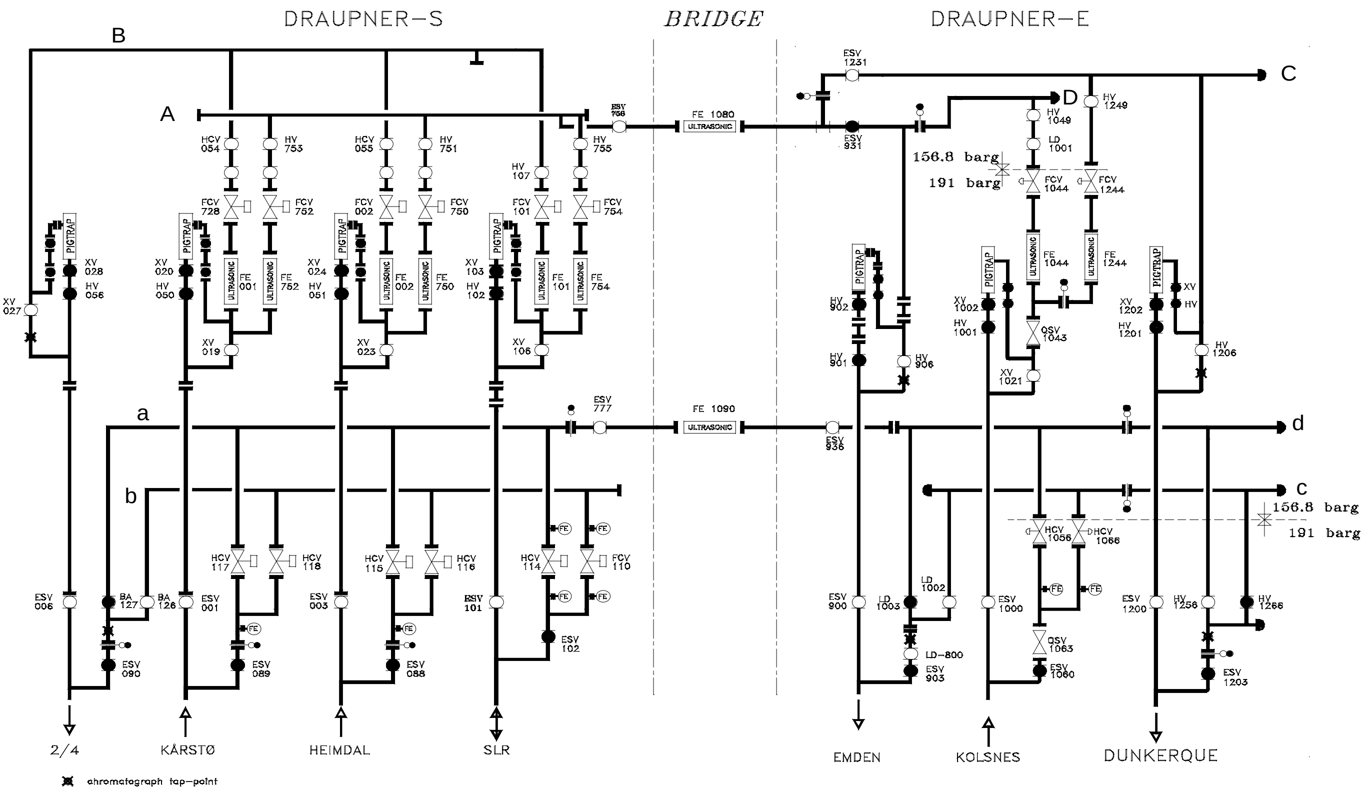


Fig. 6.2.1-A – Draupner flow diagram

Today the Draupner platform is operated by GASSCO, however the philosophy has changed since most USMs are no longer used for fiscals purposes.

DB&B TRANSDUCER

Experience from USMs installed during Statpipe and Europipe I projects has shown transducer problem due to liquid in the pipe; picture 6.2.1D is evidence of today's situation. This required chord transducers pairs to be replaced frequently (usually lowest level) and consequently the meter to be shut down with depressurisation of the line.
To overcome this operation one DB&B valve was specially designed for USM's transducers in 1990's during the Zeepipe project involving AKER KVÆRNER. The fig. 6.2.1B show the valve and transducer assembly and picture 6.2.1C show the assembly on the USM.
Six ultrasonic meters from Daniel ranged from 20", 24"and 30"were installed with this item allowing replacement of transducers pairs with meter under full operation.
It should be noted that during USM calibration one chord failure test was performed at British gas to prove meter accuracy, this is now part of Norsok Standard I-104 Chapter # 5.2.2.4.

This "sub–product" was of great advantage due to lack of space around the meters as we could not install any retractable hydraulic tools. (On the Norwegian sector retractable tools are not so often used).

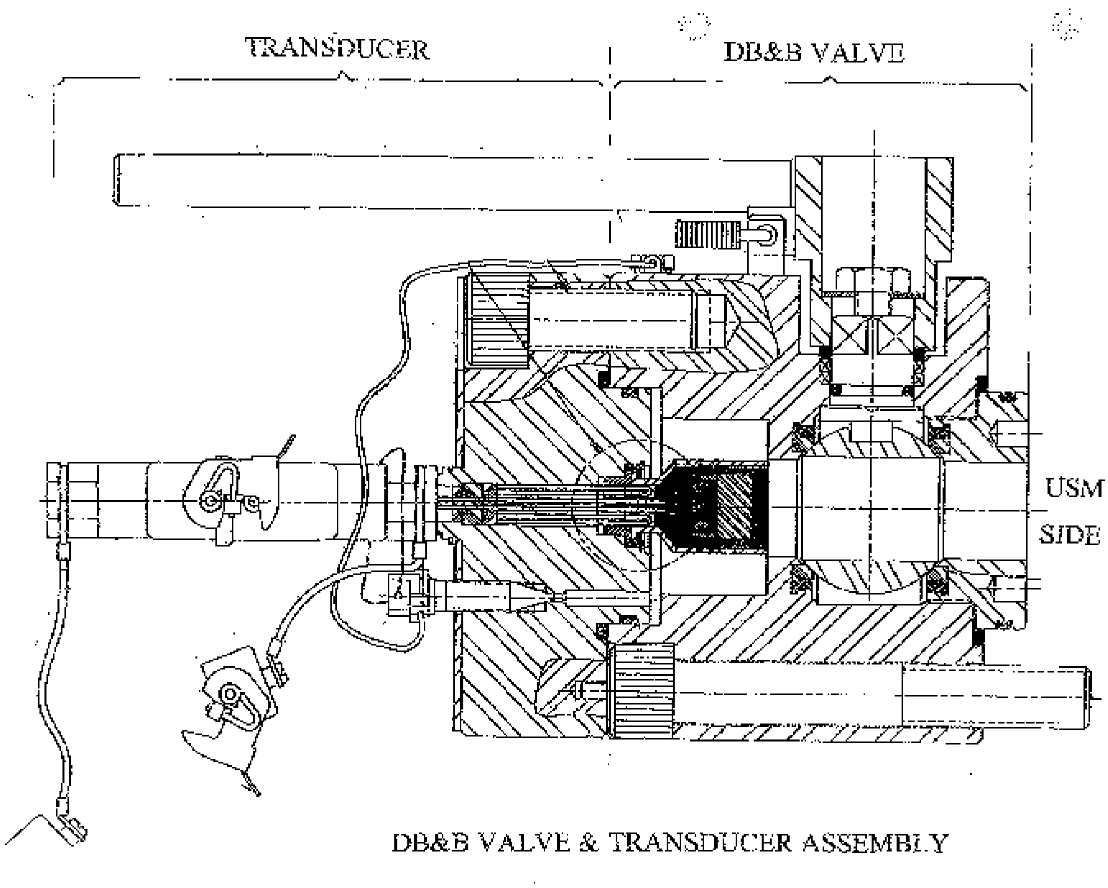


Fig. 6.2.1 B / Double Block and Bleed valve with USM transducer assembly.

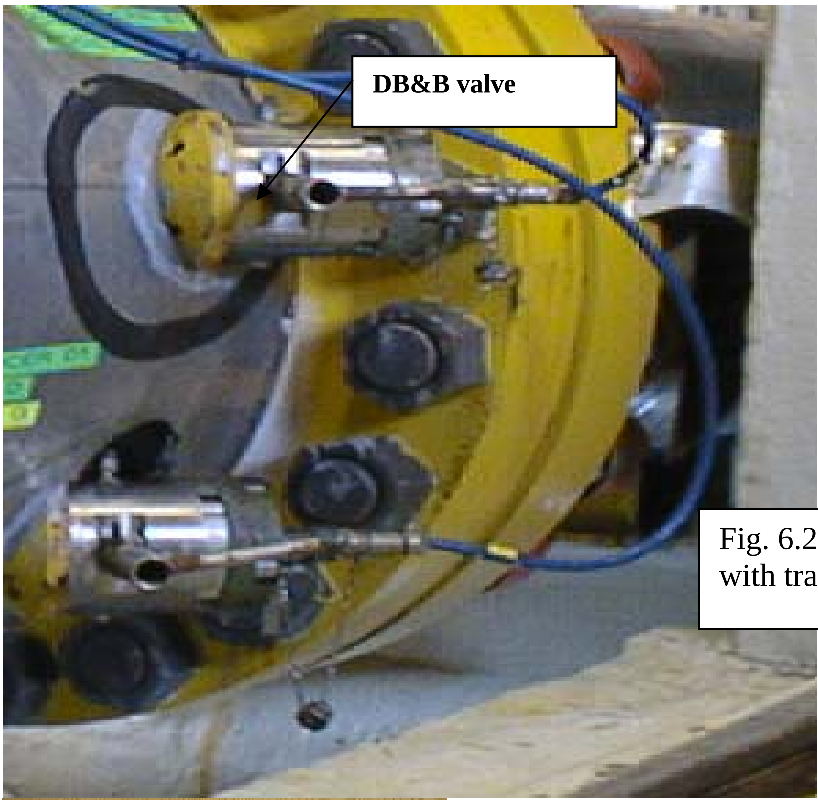


Fig. 6.2.1 – C Pictures showing DB&B valve with transducer assembly on Daniel USM.

Fig. 6.2.1 – D Pictures showing two transducers, one heavily polluted with oil.

CALIBRATION CHAMBER

The Draupner platform has a total of 12 USMs installed during two different periods where only 7 USMs transducers were equipped with DB&B valves. These 7 USMs totalising 60 transducers (28 pairs) convinced Statoil to install on board the platform a transducer calibration rig in order to perform this activity saving time and decreasing this OPEX.
The system is adapted for the two different type of driving unit Mark I and Mark II installed on the platform. New transducer assembly test certificates are issued by the platform in order to update the metering log book, (New Chord average Delay time, Chord Delta Time etc...).
The fig 6.2.1E shown the calibration arrangement

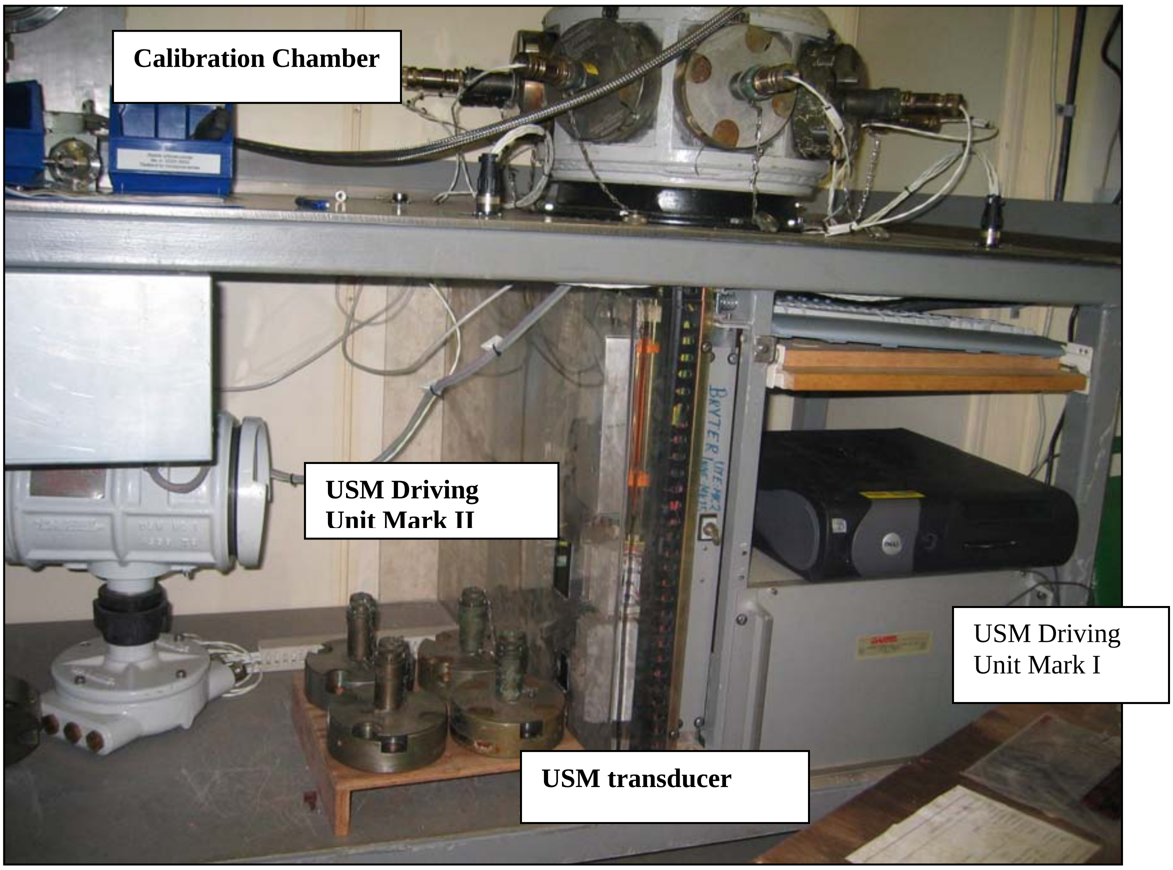


Fig 6.2.1E calibration arrangement

6.2.2 SLEIPNER PLATFORM

A wet gas sampling panel was specifically designed by Aker Kærner to gather water and condensate from Alfa Nord tie in to Sleipner west. This was required by shell in order to have the ability to, analyse C10+ fraction, CO_2 determination and calculate MEG (methanol) content.

The sampling is done by routing the process stream through a sample container. A pressure reduction valve is installed upstream the sample container. The pressure drop over the valve and succeeding temperature drop will generate liquid fallout. The liquid will be collected in the sample cylinder. The gas sampling is done by connecting a standard sample cylinder with backpressure to the sample container.

Water and condensate sampling must be done when it is expected that there is liquid in the sample container. The sample line from the process will then be closed and the pressure reduced to atmospheric conditions. Standard sample cylinders will be connected to the bottom of the sample container to take samples of condensate and water.

The fig. 6.2.2 A shown the flow diagram

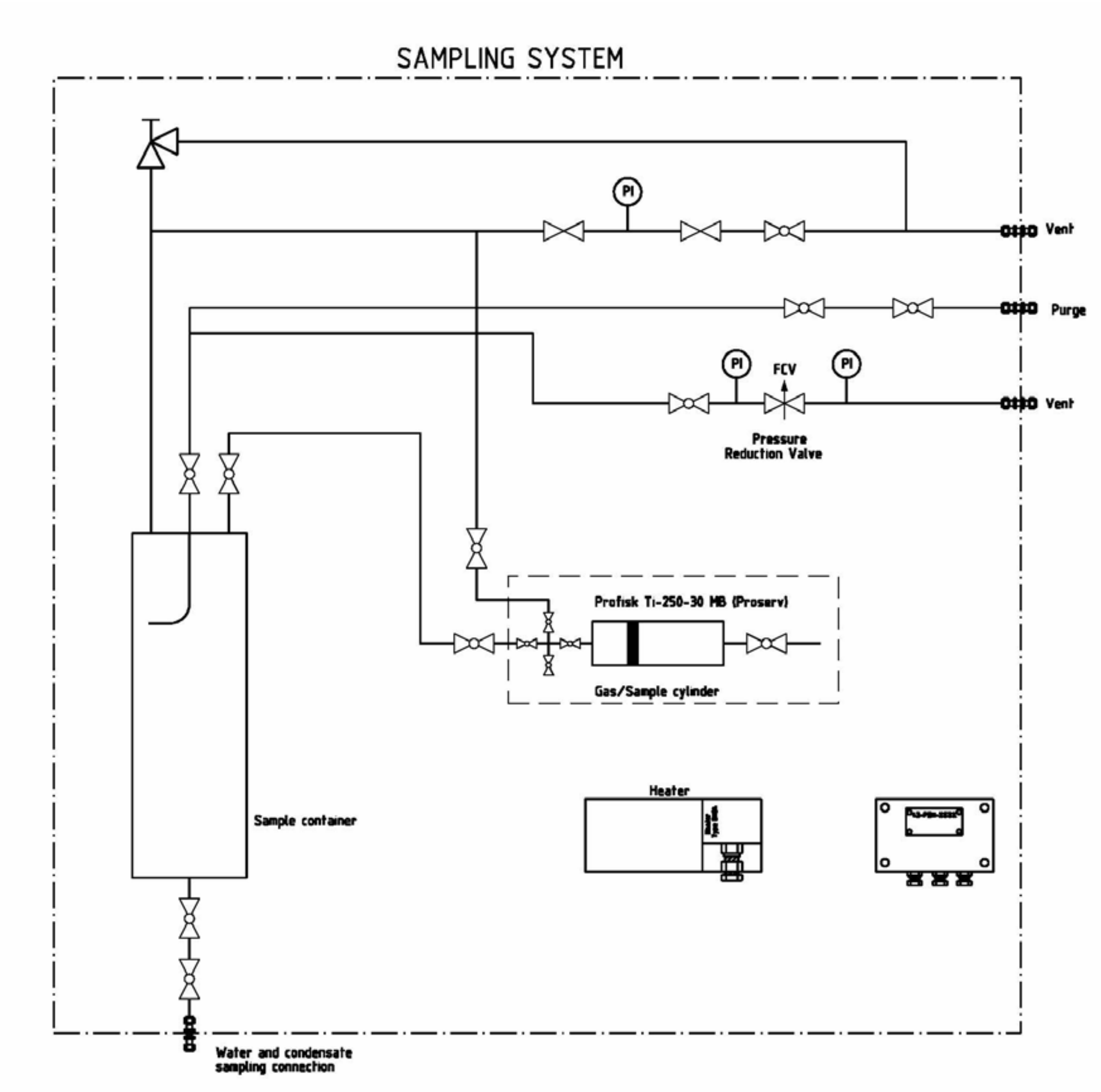


Fig. 6.2.2 A Sampling panel flow diagram

7. SPACE AND WEIGTH

The objectives "Weight and space saving" are certainly one of the most important factors for the installation of flow measurement equipment on an existing platform where lack of space is a major challenge for the engineering contractor and can influence the customer to proceed (due to increase cost).

These two factors can be reduced and can involve both "main" and "sub product" as classified in chapter 6. The following are two typical examples that demonstrate space and weight considerations. They are taken from the Draupner platform and the Gullfaks fields.

7.1 Draupner

One of the challenges very often met in the installation of new fiscal metering is lack of space in the existing flow metering cabinets, that are required to house new computers and to connect field devices.
As already mentioned in the chapter 6.3 in Draupner phase II with new Daniel US meters of type Mark II that were integrated into the existing metering systems. Previously 6 USMs installed on S platform were of type Mark I.
The main difference between Mark I and II is that signal treatment is done in a safe area for the Mark I while signal treatment for Mark II is done locally. Consequently most of the space in the metering room was occupied by the Mark I USM. By upgrading some existing Mark I meters to Mark II, space could have been easily recovered from existing panels, creating new places for new equipment such as new supervisory computer for the all Draupners USM.
If control room space is critical for a new study one should always consider looking for the possibility to gain space by upgrading equipment.
As demonstrated, this approach can be beneficial as the cost of modifying the metering room (if at all possible) is out weighed by the advantages of meter upgrades and space creation.

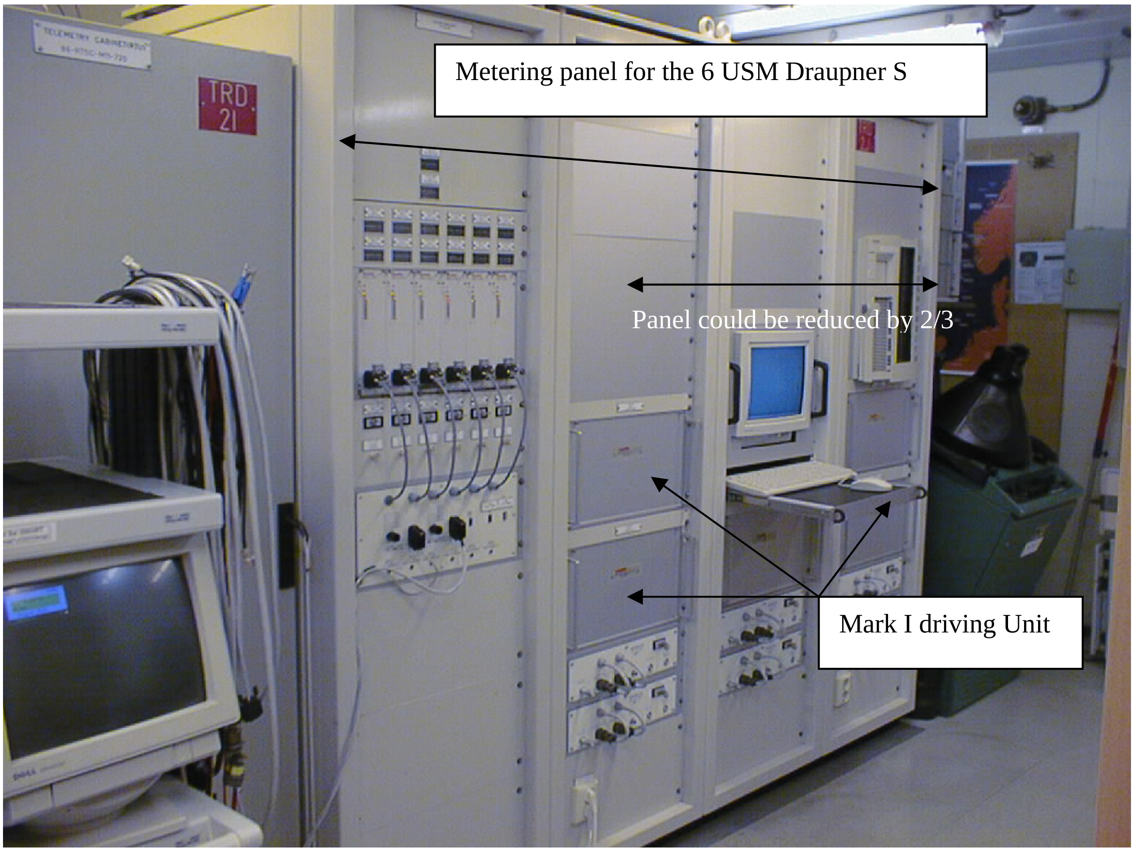


Fig 7.1A / Metering panel for the 6 USM Draupner S

7.2 Gullfaks

One example where space and weight were determining factors is certainly the Gullfaks A & C phase II project for the Gas export metering skid based on two USM runs. Started in 1999 by Statoil, the detail engineering involved different parties. Aker had the responsibility for the Gullfaks C project, UMOE was in charge of the Gullfaks A and KOS supplied the design and skid manufacturing for both platforms.
One of the main objectives and requirements stated by Statoil was to have the possibility to have a common design in order to assure calibration maintenance with one spare meter. This requirement challenged all parties to define a concept to cover all particularities from both platforms such available space, pressure drop, pipe stress level, flow capacity , upstream downstream length (with space for two densitometers), finally temperature and pressure transmitters used for the comparison integrity condition monitoring.
After a long process involving; offshore survey, calculation, several layout options were reviewed by all parties with the following result:

<u>Gullfaks C</u>

a) 2 x 14" USMs and 20ID meter tubes, carbon steel, FC11A spec.
b) 2 x 12" USMs and 20ID meter tubes, carbon steel, FC11A spec.
c) 4 x 10" USMs and 20ID meter tubes, carbon steel, FC11A spec.

<u>Gullfaks A</u>

d) 2 x 14" USMs and meter tubes, duplex, FD22XA spec.
e) 2 x 12" USMs and meter tubes, duplex, FD22XA spec.

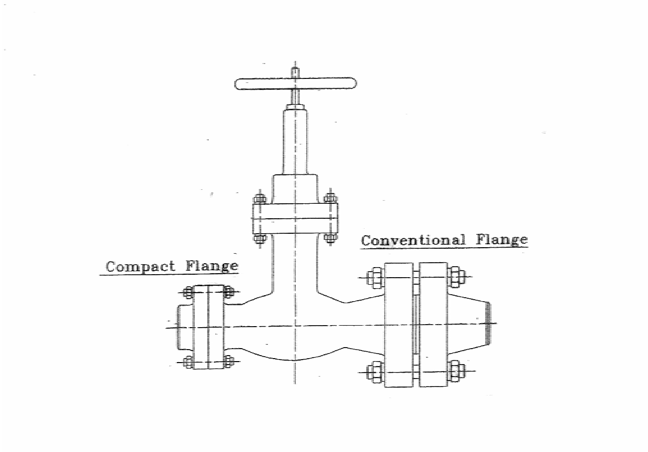
Finally the option e) for the Gullfaks A was retained with one of these advantage using Duplex material combine with compact flange instead of ANSI, weight and space was reduced (7 tons could be saved and overall length reduced).

Following, weight table's comparison are given as example. The Fig. 7.2.A /shown a typical Dimension flanges comparison

<u>Flanges Weight Comparison</u>

Flange Type	Dimension	Weight Duplex	Weight Carbon Steel	Saving %
ANSI	12"-1500#	296 kg	303 kg	**2,3 %**
Compact	12"-1500#	89 kg	91 kg	
Saving %		**70 %**		

Fig. 7.2.A / Typical flanges dimension comparison.



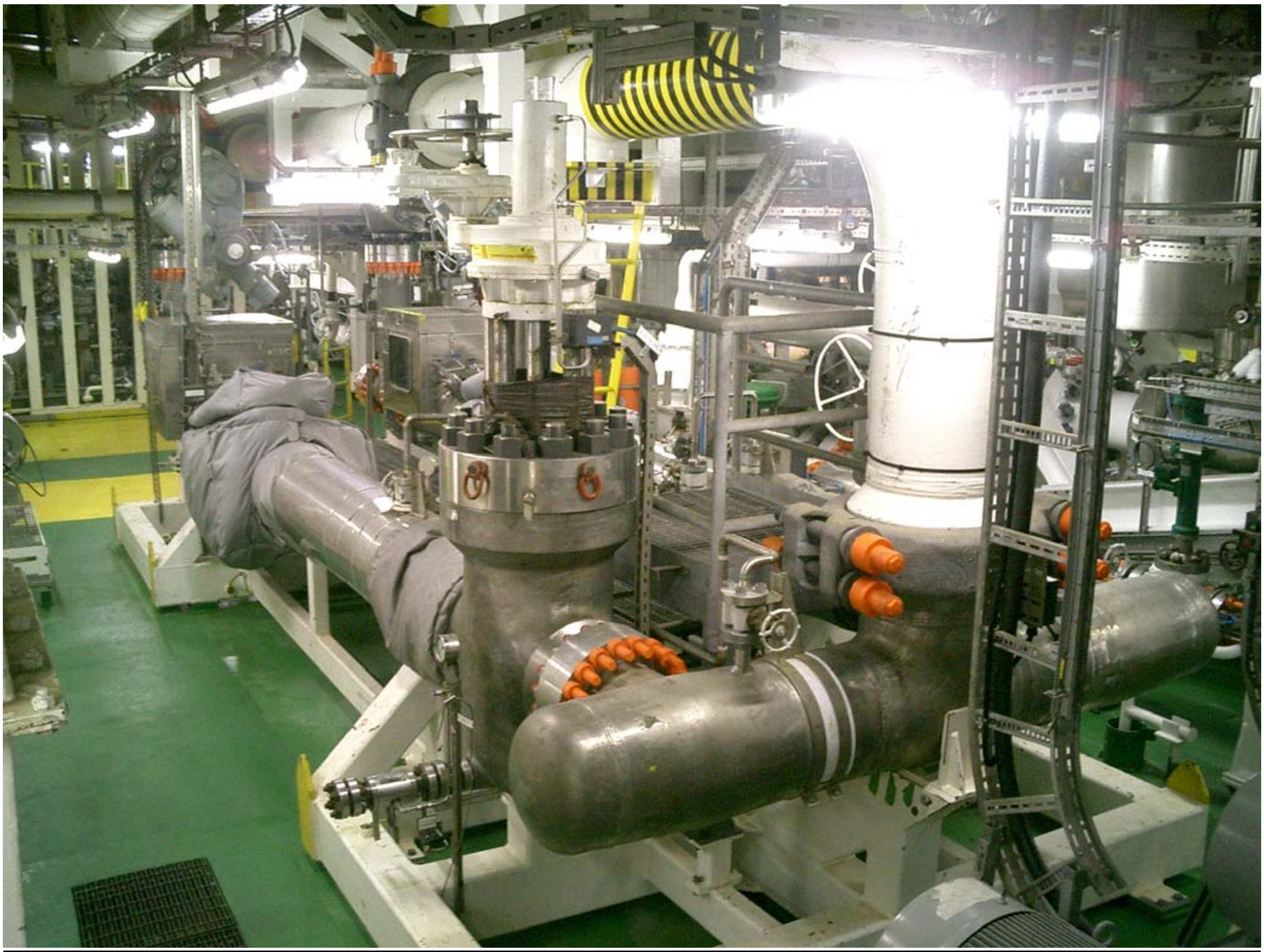


Fig. 7.2.C / Gullfaks C Metering Skid

8. INSTALLATION

Satellites fields with their sub sea wells are usually connected to existing platforms topside facilities according to two concepts depending on platform feasibility, new module or integrated on existing facilities.

8.1 New Module

One concept is to integrate a new module on existing platform, restricting offshore hook-up and commissioning. This offers an ideal situation where metering skid; manufactured and partly commissioned at vendor premises offers the maximum guaranty to the project.
Such an example is on the Bp Blane field in the British sector which will be connected to the Ula Platform located in the Norwegian sector. The figures 8.1.A / shows a concept model done at the preliminary study stage (concept).
This model was produced with readily available material and was made by one person in a short time and corresponded to BP design expectation. Metering skid can be identified "symbolised by plastic straw".
<u>(Sometime it feels good to know that pure craft work talent is still needed and appreciated).</u>

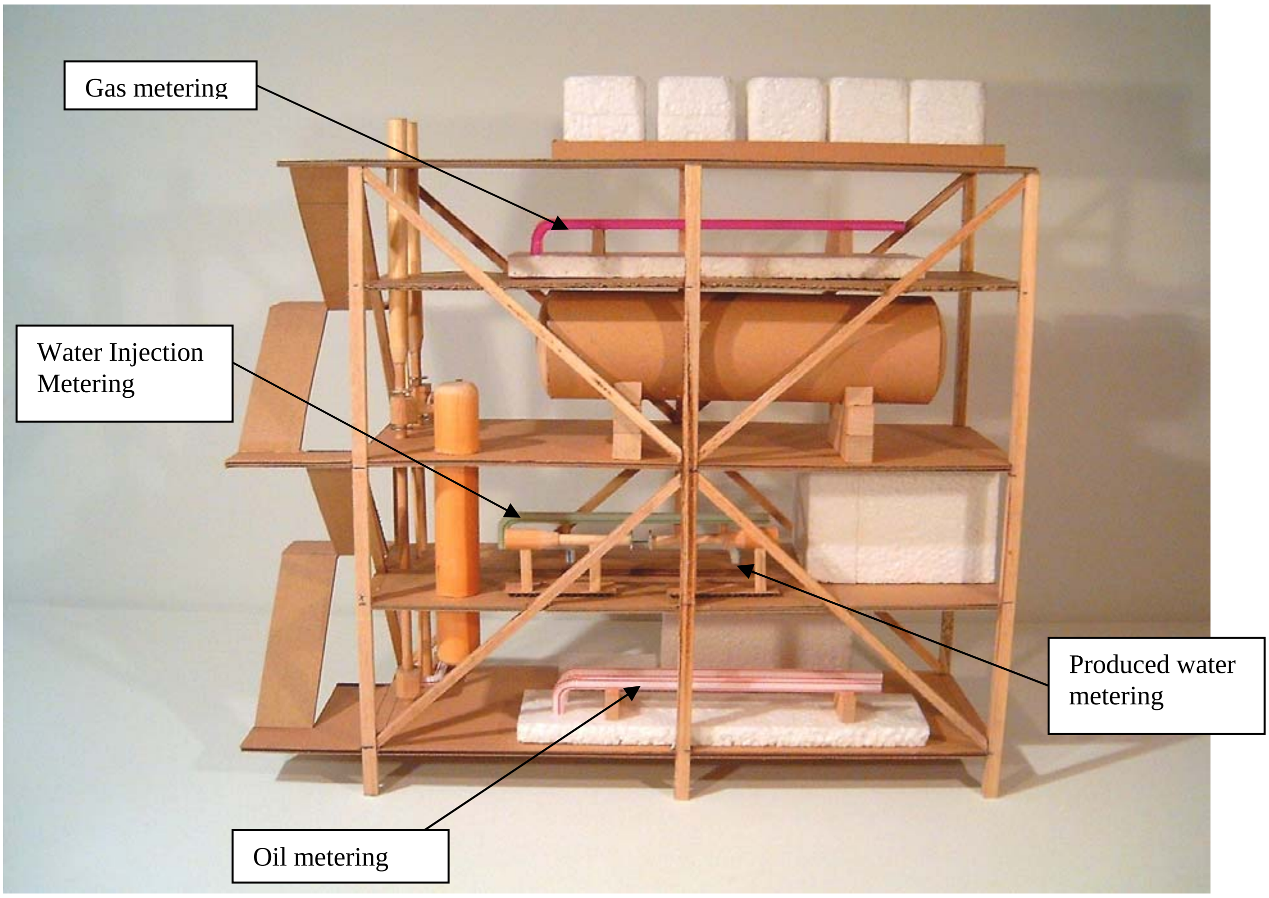


Fig.: 8.1.A / Blane concept model "now on 3D CAD"

8.3 Integrated skid

Sometime new satellite field requires having this fiscal flow metering skid to be integrated into existing modules. In this case flow measurement skid can be often subject of several concept scenarios. Most of the time study is reviewed together with selected vendor during the details engineering phase**.** These installations can require sometime considerable pre-commissioning work offshore in order to allow the new metering skid to be integrated with existing systems and this may involve demolition or temporary equipment locations such cables tray etc.

This work demands close co-ordination between different engineering disciplines, including meter skid vendor and eventually his sub-suppliers with offshore survey to review all feasibility in order to minimise installation work and time offshore. This can be a complex process and need to be evaluated in order to estimate the realistic man-hours necessary to complete all work task to the start up date**.** Gullfaks C phase II is a typical example, the metering skid installed in the module M24 D required the three main parts; inlet manifold, meter runs and outlet manifold to be divided into several sections in order to be re-assembled in place.

Fig.8.3-A shown the metering skid for the two gas meter runs assembled.

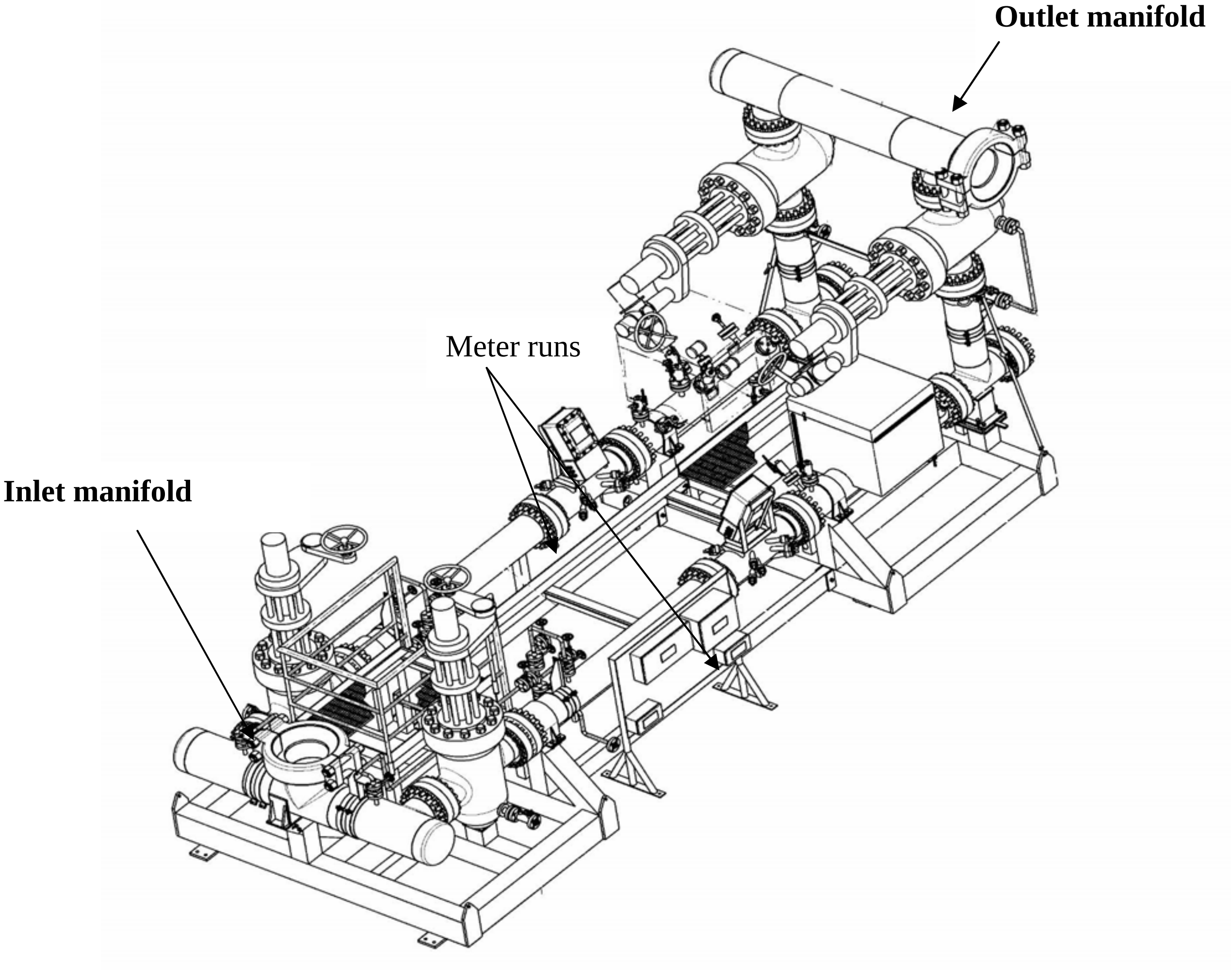
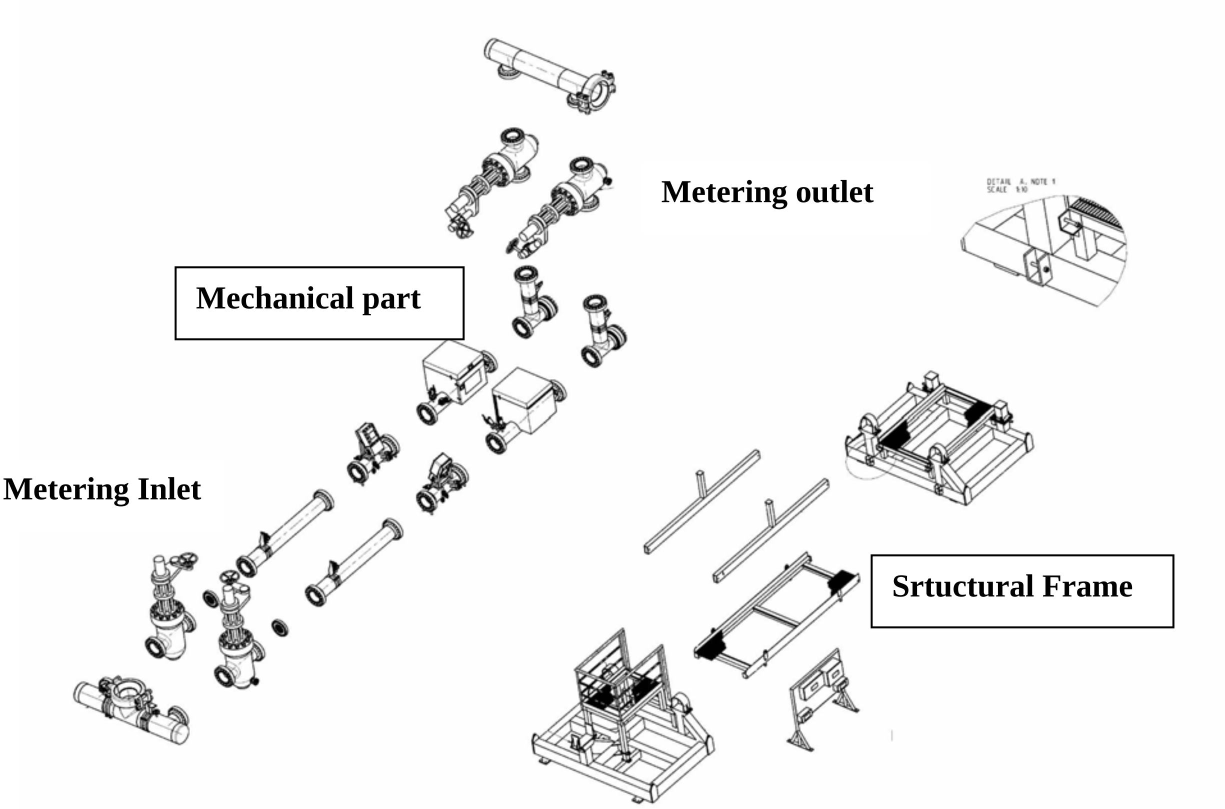


Fig. 8.3.A / Gullfaks C Phase II Gas Fiscal metering skid.

The skid was pre-assembled at FMC sub-supplier yard and tested before it was dismantled as shown on the Fig.: 8.3B and shipped as loose items. FMC issued a very detailed installation procedure with the main purpose to describe the methods and operations required to the Contractor (AKOP) in order to ensure that the dismantled gas metering skid was transported and installed in the correct manner by suitably, qualified personnel under the supervision of FMC representative.
The procedure highlighted several of the following aspects: transport, storage, handling, lifting, and installation (mechanical & Instrumentation) including the N2/HE leak test.

The installation was accomplish during 2 offshore rotations involving 4/5 technicians and one supervisor from FMC.



The fig. 8.3.B / shown the skid dismantlement overview.

9. VENDOR & ENGINEERING CONTRACTOR EXPECTATION

From the day of Purchase Order up to the start up, Vendor and Engineering Contractor will have to fully co-operate and establish a good confidence in order to both assume the entire responsibility to their respective tasks and to complete the job at the satisfaction of the end user “Oil Company”. This requires a constant follow-up for the delivery of every milestone, as defined in “PEM/TME”. From experience from main project, Aker Kværner does not usually expect major problem but it is important that if any question should arise from vendor or Engineering contractor they should be highlighted at once to the end user (Oil Company) as they could have consequences on the start up date.

10. CONCLUSION

Aker Kvaerner as an Egineering Contractor has been an actor in MMO from the start of the North Sea oil and gas fields development.

With a multi-discipline knowledge in fiscal flow measurement projects and extended experience in integrated metering skids and new modules, Aker Kvaerner is a key player to successful co-operation between vendors, PSA and clients.

Failure to identify problems at an early stage (construction site problems, late documentation, test procedures, planning changes etc.), may have disastrous consequences to the project and the engineering company. It is therefore a pre-requisite that the engineering company must be able to identify and resolve such problems in a professional manner.

Conducting offshore surveys is a very important part of this process. Aker Kvaerner is continuously improving applied engineering tools, using new technologies in order to reduce study time and installation cost. New technology as a “main product” is a very important part where Aker Kvaerner follows the development and gets acquainted with possibilities and limitations.

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