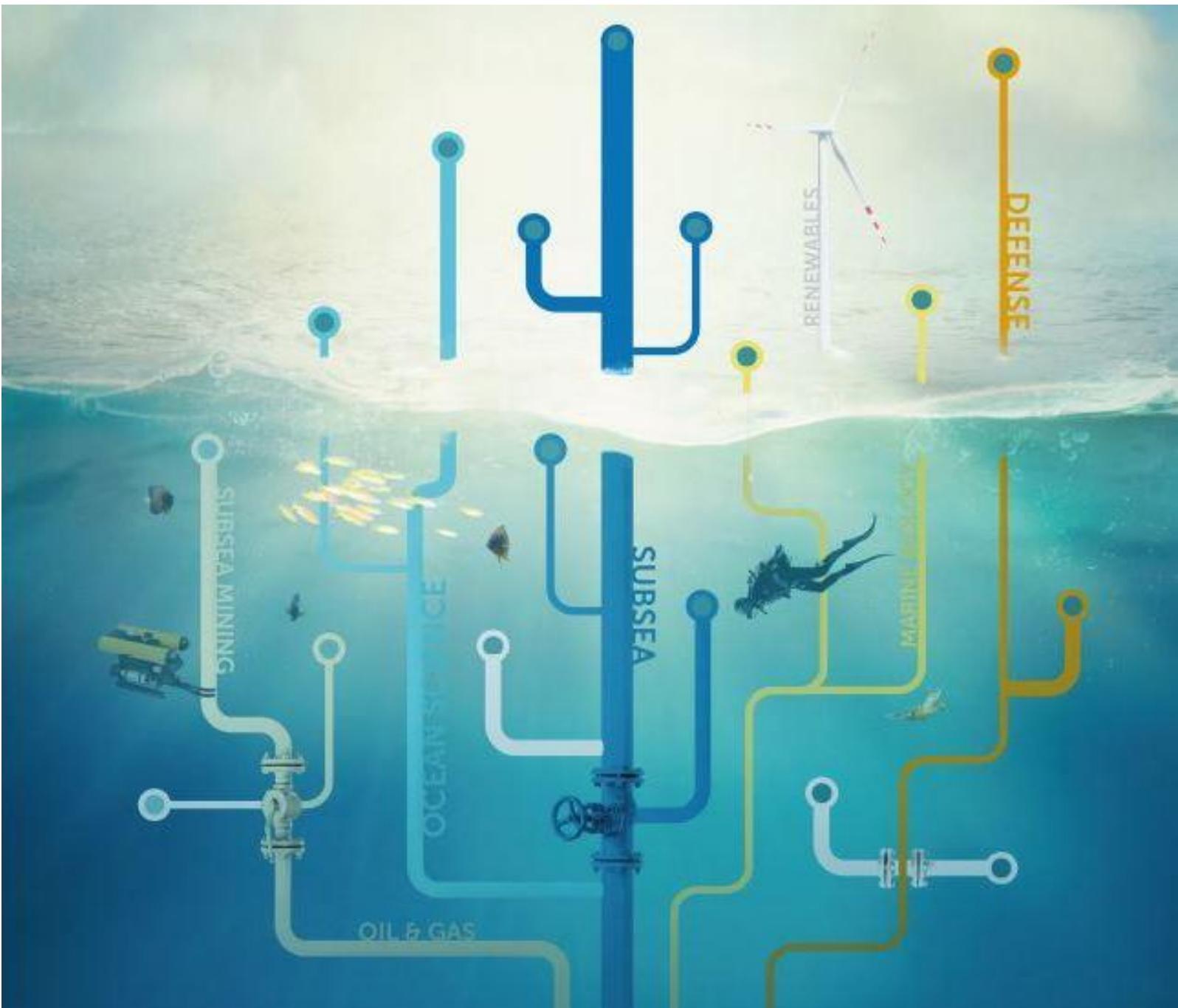


Flow Assurance: What has the industry learned over the last 30 years

Thursday 28th March 2019

Pitfodels Suite

Norwood Hall Hotel



09:00 Registration

09:30 Steve Sasanow

09:45 **Twenty-five Years of Evolving Flow Assurance Integration within Subsea Field Development**



Murray Anderson
Flow Assurance
Director
Crodall Energy

Over the past twenty-five years flow assurance analysis has become fully integrated within the field development process. Detailed flow modelling is now routinely used throughout the engineering design cycle. This has significantly improved the predictions of data relied on for subsea operability design. The availability of accurate modelled data during the early design phase has allowed engineers to reliably predict and optimise production across the field life and to quantify the risk of flow assurance problems.

Advances in data collection, assessment and modelling now allow reliable integrated production modelling from the reservoir through to the receiving facilities. Software can accurately assess operating scenarios at both normal steady flowing conditions and transient conditions. By doing so, engineers can now fully understand the system behaviour and optimise designs before a development comes on-stream.

The results of early and detailed design phase simulations allow engineers to develop robust integrated operating strategies which mitigate against flow instabilities and manage the risk of flow restrictions and blockages.

The recent development of web based interfaces linked to online monitoring has allowed flow assurance analysis to be further integrated into the production management of operating fields. Online monitoring tools have been used to deliver a real time picture of parameters that cannot be easily measured directly, allowing operators to take the correct actions in a timely manner to ensure flow assurance and operability issues are avoided.

A summary of the progress is identifying, analysing and accounting for flow assurance challenges over the last twenty-five years is presented, along with a discussion of the impact this has had on the subsea upstream industry.

Murray Anderson is the Technical Lead for Subsea Field Development Engineering and Flow Assurance for Crodall Energy. Murray has been a Subsea and Pipeline Engineering Consultant since 1995, prior to which he was a University Lecturer in Mechanical and Offshore Engineering.

Murray has extensive experience of subsea system thermo-hydraulic simulation using commercial tools such as PIPESIM and OLGA for multiphase flow simulations. He has also developed bespoke thermo-hydraulic analysis techniques for field development engineering, and is a specialist in subsea heat transfer. He has worked on numerous

subsea concept development studies, addressing option selections, field layouts, equipment configurations and cost screening.

Murray is a Chartered Engineer and a Fellow of the Institution of Mechanical Engineers.

10:15 Flow Assurance... Escaping the Constraints



Conor Sherrard
*Senior Flow Assurance
Engineer*
**Assured Flow
Solutions**

Due to the high capital expenditure, high environmental risk, uncertainty in operating conditions and harsh operating environments associated with offshore oil and gas developments, the design of offshore oil and gas systems are inherently conservative. Historically, this has resulted in many offshore fields being considered not commercially viable, leaving millions of barrels of oil trapped below the surface.

Many of the prohibitive margins applied to subsea systems result from a lack of understanding of the physics behind oil and gas production, and even more so from a lack of understanding between oil and gas disciplines.

This presentation will discuss how a better understanding and integration between production chemistry and flow assurance, along with better integration between design and operations, is enabling the removal of prohibitive design margins without compromising the safety and reliability of operations. Examples will be presented of projects around the globe where the application of a deeper knowledge of flow assurance has driven projects to FID.

Conor is a Senior Engineer with London based oil and gas consulting company Assured Flow Solutions and is responsible for the delivery of integrated flow assurance and production chemistry projects. He has worked in the oil and gas industry for 7 years in the areas of field development, process and flow assurance engineering, having previously worked in consulting roles at Wood and Schlumberger in Western Australia. Conor has a diverse range of experience which includes working on both oil and gas dominated systems in Australia, South East Asia, the North Sea and Africa.

10:45 Coffee

11:15 OGTC Marginal Developments – The Flow Assurance Challenge



Niki Chambers
Project Manager –
Marginal
Developments
OGTC

In the UK North Sea there are more than 300 known but unsanctioned and undeveloped “small pools” of oil and gas. In total, they contain a total of more than 3 billion barrels, which represents a significant prize for UK Plc, if ways to develop them economically can be found.

There are a number of technical and economic reasons why many small pools have not yet been developed. Through its Marginal Developments initiatives, the Oil & Gas Technology Centre (OGTC) is looking for ways to make as many of these discoveries economically and technically viable.

Flow assurance is a key part of the challenge and one of the areas of focus within all the initiatives.

The OGTC is working with the operators, the supply chain and technology developers to provide solutions that will meet the industry needs and requirements. The OGTC co-funds projects to develop and deploy new technology in the UKCS.

The Marginal Developments solution centre has a number of projects undergoing or progressing towards field trial, with a number of opportunities and ideas currently being developed. The adoption of these technologies will not only benefit these undeveloped small pools but have application in the wider brown and greenfield activities.

The presentation will provide an overview of the technologies that have a specific flow assurance focus and will share the areas of success and where getting engagement from the end user has been more problematic. The presentation will also discuss what is still to be addressed and the flow assurance challenges that require new or improved technologies.

Niki is a Project Manager in the Marginal Developments Solution Centre at the OGTC. Niki has over 25 years experience in subsea engineering and is a specialist in production and flow assurance. She has held technical and management roles in a number of engineering companies prior to joining the OGTC.

11:45 The hidden truth about subsea multiphase boosting



Morten Stenhaug
VP Production
Technology
OneSubsea
Schlumberger

The first subsea multiphase boosting system was installed in 1994 and is today a proven technology with a global track record. In addition to bringing increased production and recovery, multiphase boosting may also reduce flow assurance issues, reduce project CAPEX and OPEX, improve operability and safety as well as reduce the greenhouse gas emissions when compared to the often defaulted gas lift. However, subsea boosting is still far from being the standard artificial lift method for subsea field developments, and the industry may lack a complete overview and an approach to uncovering and quantifying the actual value. This paper summarizes the different aspects of subsea artificial lift using experience from the more than 30 installations and provides a value-based approach to uncovering the true value of subsea multiphase boosting.

Morten Stenhaug is today Vice President Integrated Solutions and Production in OneSubsea. After graduating he spent 15 years with various oil companies, including Statoil and Hydro, now Equinor, working within Petroleum Technology, Completions, Subsea and Flow Assurance and was also managing field development design, production optimization and field operations. He joined Schlumberger in 2006 to help build the Schlumberger subsea business. He is today heading the integrated field development business of OneSubsea with a global organization of field development experts that are passionate about adding value to field developments and helping clients meet their investment decision criteria.

Morten has a degree from the Norwegian Institute of Technology and Science with a Master's in Petroleum Technology. While his home country is Norway, he is currently based out of Houston.

12:15 Challenges to Traditional Wax Management Approaches



Jacqueline Geddes-Smith
Production Assurance
Manager
Xodus

Wax management is a key risk issue that Flow Assurance engineers must address within overall field development design and the management of assets.

A key factor to this is a firm understanding of the behaviour of wax across expected operating ranges and how this may influence the decisions taken, and constraints placed upon the operating asset.

Often, we see wax properties of fluids condensed to a table within a Basis of Design which shows little of the expected behaviour and places potentially heavy conservatism on the design approach, possibly leading to expensive decisions relating to thermal management of your system and operations intervention requirements being set out for wax management across the life of the asset.

How can we challenge this basis to provide enhanced guidance on the behaviour of wax within pipelines and to challenge the operating philosophies in place as a means of design and operability optimisation?

Jacqueline Geddes-Smith is the Production Assurance Manager for Xodus in Scotland and a Principal Flow Assurance Consultant. She has over 18 years of industry experience providing support to a range of UK and international clients, covering the project lifecycle. With involvement in a number of high level concept studies, Jacqueline also has extensive experience in the Front End and Execute project stages as well as experience in operations support and latterly, decommissioning. She has proven experience in the delivery of solutions to complex flow problems and in determination of Flow assurance issues, and the integration of the requirements for mitigation or management of these within overall design and operations contexts.

12:45 Lunch

13:30 OGTC – Pseudo Dry Gas: West of Shetland Gathering system for stranded pools – Project Update



Andy Robertson
Field Developments
Manager
Advisian

An update of the ongoing study to consider the economic impact of applying the innovative Pseudo Dry Gas technology to stranded gas fields the West of Shetland making a gas gathering corridor stretching 200km and 1.6km deep.

Due to laws of physics and multiphase flow, subsea tie back systems have been generally limited to around 100km as a single pipeline or 140km as dual pipelines after which the production plateaus are shortened and increasing amounts of reserves remain in the ground. This is primarily due to increasing back-pressures within the gathering system generated by a combination of increasing frictional and gravitational pressure drops. The gravitational pressure drop is due to increasing liquid hold up (liquid content in the pipeline) condensed from the gas as it is transported, this results in a regressive cycle feeding into ever lower returns for the developer the further the subsea tie-back is extended. Therefore once this threshold has been passed, there is a step change in costs for the development in the order of US\$100's millions for energy companies.

Pseudo Dry Gas system dramatically reduces pressure drop within multiphase pipeline allowing significantly longer and deeper gas tieback, without impact to recoverable reserves. All this while typically lowering operational Co2 emissions by 100k + tonnes / year.

Andy is a production assurance specialist with 25 years' experience in the up-stream oil and gas business and was one of the founders of Ingen, which is now part of Advisian.

Andy's expertise covers reservoir, subsea pipeline, topsides facility and export design, operation and economics. He has supported many projects from the feasibility stage through detailed design to offshore hook up, commissioning and start-up. This skill set and range of experience together with the tools and methods developed by Ingen means that he is able to quickly identify the optimum field development solutions.

Andy's experience has developed over a large number of marginal fields where his skill set facilitates an integrated and holistic approach helping to unlock the value in these developments often requiring innovative technology and approaches. Doing this requires a detailed appreciation of all aspects of the development covering subsurface, subsea, topsides and commercial. Since the year 2000, this approach has been consistently successful in its application with Ingen having successfully supported the development of over 20 fields for clients in the UK and overseas.

14:00 Identifying and characterising Flow Assurance Issues with the world's only field proven subsea CT scanner



Mike Banks
*Business Development
Manager
Tracerco*

Flow assurance specialists have long faced the challenge of maintaining continuous flow throughout subsea pipelines. Over time, deposits can build up - leading to potential blockages, restricted production and ultimately a shortfall in revenue. When these issues arise, operators are faced with the problem of determining the exact location, extent and nature of the build-up / blockage, without risking damage to the pipeline, or making the blockage worse by improper corrective action.

Research indicates that 50-80% of remediation attempts fail first time. This is largely due to a limited knowledge of exactly where, what and how much material is causing the blockage. Attempting remediation more than once at least doubles the cost, and whilst there is lack of full knowledge of what the blockage is, or the extent of it, the second, third or fourth remediation could still fail.

This presentation will illustrate how through the use of CT scanning, operators can pinpoint exactly where a blockage is in a pipeline, how much there is, and identify the nature of the material in real time, without any interruption to production of normal pipeline operations. The presentation will also discuss a real case example of where CT scanning was used to provide critical flow assurance information to an operator, allowing them to formulate an appropriate remediation plan.

Mike has over 30 years' experience in the offshore industry and is one of Tracerco's experts in subsea applications. Starting out as an assistant field engineer, Mike has progressed through the ranks, holding senior field engineer roles before moving onto project engineering and management. Mike is now a Business Development Manager for Tracerco's Measurement Insights business. Mike has a BEng(Hons) degree and is a member of the Institute of Diagnostic Engineers.

14:30 Afternoon break

15:00 **Improving subsea temperature sensors reading accuracy, a review of previous projects findings using CFD at Wood**



Christophe Meynet
Senior CFD Consultant
Wood PLC

With the constant request of productivity increase, Flow assurance engineer are often confronted to new type of problems. The main task of Flow Assurance engineer is the delivery of hydrocarbon to processing and transformation infrastructure while the process engineer tasks are to optimise the treatment of the fluid. In order to achieve this task the engineers will rely on the different measurement devices located throughout the subsea equipment. Therefore, accurate temperature and pressure readings during the subsea production are one of the key parameter In order to optimise the hydrocarbon production. Those measurements are the only information available to the flow assurance and production engineers. Inaccurate reports can lead to bad decisions which can jeopardise the integrity of the equipment, fluid temperature being above the equipment temperature specification for instance.

In addition, the production will evolve during the life of the field and the flow regime within the equipment can significantly change between the early life and the end of life of the field. Therefore, measurement equipment should be able to manage the change of flow regime and still deliver accurate readings

The author will demonstrate based on an extensive CFD analysis how the flow regime and the sensor design can significantly affect the temperature readings. Different flow regime such as stratified, annular or intermittent will be investigated and the transient response of the sensor will be analysed based on the position and the design of the sensor and the surrounding structure. Comparison with field measurement will be also presented when available.

Christophe studied Engineering at the Ecole des Mines d'Albi-Carmaux specialising in fluid mechanics and Computational Fluid Dynamics (CFD). He graduated in 2008 with a Master's degree.

He joined Prospect Flow Solutions in Aberdeen in 2008 then moved on to Wood plc in 2010 to specialise exclusively in CFD.

Christophe is a Senior CFD Consultant since 2012 and provides CFD services for all the different parts of Wood. Typical applications of CFD at Wood include:

- *Flow assurance*
- *Gas dispersions*
- *Thermal studies*
- *Erosion studies*
- *Process equipment design & optimisation*
- *Fluid Structure Interactions*

15:30 Gas Hydrate Management in the Digital Era



Chika Uduma
VP Sales & Marketing
Blue Gentoo Ltd

Of the 4 components required to form hydrates (Pressure, Temperature, Water and Gas) only 2 are typically monitored in real-time to determine the risk of hydrates blockage. The other two are provided for by applying contingencies and high safety margins to hydrates management strategies.

Advances have been made in the management of gas hydrates, but the industry still relies predominantly on simulating pipeline flow characteristics and lacks critical real-time information the parameters which require to be monitored; especially information on the changing characteristics of the gas and aqueous phases.

Blue Gentoo has a system which accurately predicts the formation of gas hydrates, assesses current safety margins and calculates the most effective and cost-efficient way to manage gas hydrates risks, while controlling chemical injection to optimise inhibition while avoiding process upsets.

This offers major benefits for operators looking to adopt a risk-based approach to gas hydrate management or to reduce the quantity of chemicals injected into their systems and the consequences thereof.

Chika has a background in subsea and sub-surface product design & development with large service companies and technology-based SMEs (Weatherford and Brinker Technology). He also has experience of oilfield sales and focusses on building customer relationships and understanding their pain points and value drivers. He has worked in the North Sea and West Africa.

16:00 Close