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SOCIETY OF PETROLEUM ENGINEERS

SPE NEWS

COPENHAGEN SECTION

CONTENT

A PROMISING START TO 2018

We kicked the new year off with the Hess event and hopefully everyone who attended is a little wiser on how to implement LEAN and how it's benefits are felt in the good times as well as the bad.

The guessing games continue as to where the markets are heading and companies continue to react, convulse and second guess. Brent has broken 70 USD/BBL and is hovering around a level not seen since December 2014. The difference between then and now is that the gradient has gone from being a negative one to a positive one and this is being reflected by the increased number of job opportunities being posted globally and a tempered sense of optimism.

Optimism is wonderful attribute to have, but over optimism can do more harm than good. One person who knew this well was a US Navy Vice Admiral called James Bond Stockdale who was a prisoner of war for 7 years during the Vietnam war. While Stockdale had remarkable faith in the unknowable, he noted it was always the most optimistic of his prison mates who failed to make it out alive. What the optimists failed to do was confront the reality of their situation. This has been immortalised in something known as the "Stockdale Paradox."

Membership to the SPE gives you access to a large number of tools and resources that might or might not help you. You have access to a whole library of world class technical publications, webinars, online articles, bulletin boards all for free and all available on SPE.org. And then you have the local section events where you have a chance to hear talks on subjects as broad and diverse as Big Data, Lean and Fluid Flow Simulation in Fractured Reservoirs all in the company of your peers across the industry. As a member you are very well equipped to personally weather the storm and make the best out of what has been a tough situation. Some have left the industry, some like myself have kept a foot firmly in the oil industry but have spread our bets and reduced our risk exposure by having the other foot outside, and others have toughed it out. Whatever the approach or the situation one thing is certain that as the prices continue to increase it will be tempting to forget the expensive lessons learned over the past few years and revert to the way we have always done things, it is tempting to ignore the lessons from the Stockdale Paradox.

February sees the SPE meeting being hosted by Maersk Oil and a chance to listen to one of the reasons for optimism in Denmark, namely the "Tyra Future project" and in March Welltec will host a Distinguished Lecturer and again another dose of optimism will be injected in the form of "Maximixing the Value of a Mature Asset". I look forward to seeing you in the coming year. There is much to look forward and remember…

We must retain faith that we will prevail in the end, regardless of the difficulties but at the same time must confront the most brutal facts of our current reality, whatever they might be and work to overcome those. When it looks like everything is going in the right direction and oil is predicted to hit 100 USD/BBL by Christmas it is probably best to "Stockdale" the optimism and recalibrate the expectations. ◄

Anders Krag
SPE Chairman
Copenhagen Section

FUTURE MEETINGS

FOR MORE INFORMATION REGARDING THE PROGRAMME SEE PAGE 6

Graphic design & production: nectarcph.dk

SPE

COPENHAGEN SECTION

THE BOARD · 2017-2018 SEASON

Full steam ahead for Tyra redevelopment

2017 closed out with news the DUC partners had approved the largest ever Danish North Sea investment

Maersk Oil was delighted to announce in December that the Danish Underground Consortium (DUC) had approved an investment of approximately 21bn DKK in the full redevelopment of the Tyra Gas field.

The redevelopment of Tyra ensures continued production from Denmark's largest gas field, and will protect and rejuvenate important Danish North Sea infrastructure.

The sum approved also represents the largest project investment ever made in the Danish North Sea, enabling Tyra to continue operations for at least 25 years. At peak production, the redeveloped Tyra Gas field will provide enough gas to power 1.5 million Danish homes, supporting energy security, future tax revenues and employment for Denmark.

The investment cost for the modification to existing facilities and construction of new facilities (CAPEX) is estimated at 17 bn DKK, and the cost in relation to removal and decommissioning of current facilities (ABEX) is estimated at 4 bn DKK.

Blocks
5504/11 and 12

Location
225 km west of Esbjerg

Discovered
1968

Production start
1984

Reservoir depth
2,000 m

Field area
615.6 km^2

Reservoir rock
Chalk

Geological age
Upper and Lower Cretaceous

Water depth
42-47 m

EXTENDING THE LIFE OF THE DANISH NORTH SEA

Tyra is the centre of Denmark's national energy infrastructure, processing 90% of the nation's gas production. Through new development projects and third party tie-ins, the redevelopment of Tyra can be a catalyst for extending the life of the Danish North Sea – not just for Maersk Oil and the DUC, but also for Denmark.

Alongside the Maersk Oil-operated Culzean development in the UK North Sea, the Tyra Gas field redevelopment increases Maersk Oil's future exposure to gas production, an important transition fuel in the future energy mix.

The redeveloped Tyra is expected to deliver approximately 60,000 barrels of oil equivalent per day at peak, and it is estimated that the redevelopment can enable the production of more than 200 million barrels of oil equivalent. Approximately 2/3 of the production is expected to be gas and 1/3 to be oil.

In addition, the new infrastructure provides the incentive to pursue new projects in the northern part of the North Sea, where the most recent development, Tyra SE, delivered first gas in 2015 and is producing above expectations.

Speaking at the time, Maersk Oil Chief Executive, Gretchen Watkins, said: "Tyra has been a key asset in the history of Maersk Oil, and an important source of energy security for Denmark. The redevelopment of Tyra is the largest investment carried out in the Danish North Sea, and when completed in 2022, production from the Tyra field itself has the potential to cover Danish gas consumption for a decade."

Maersk Oil's Chief Operating Officer, Martin Rune Pedersen, said: "The redevelopment of Tyra is evidence of a shared interest in prolonging the life of the Danish North Sea. The investment in this globally significant oil and gas project will protect and develop jobs in Denmark, and it can enable future significant industry investments in new development projects made possible by the redeveloped Tyra gas infrastructure."

Project timeline

March 2017
Tenders for main contracts issued

Dec 2017
Final investment decision

Award of major contracts

2017-2019
Preparations for shut in and redevelopment

Nov 2019
Expected shut-in of production

2020
Wellhead and riser platforms replaced and wells extended

2020
Removal of existing process and accommodation topsides

2021
Installation of new processing centre and accommodation platform

2022
First production from new Tyra facilities

The Tyra field is operated by Maersk Oil on behalf of the DUC, a partnership between A.P. Moller – Maersk (31.2%), Shell (36.8%), Nordsøfonden (20%) and Chevron (12%).

ABSTRACT

THE TYRA FUTURE PROJECT

A full redevelopment will restore the current infrastructure, including the gas processing hub and ensure future production.

The Tyra field requires redevelopment due to subsidence of the chalk reservoir which has led to the platforms sinking by around 5 metres over the last 30 years. This has reduced the gap between the sea and the platform decks.

Today the Tyra field consists of two main centres; Tyra East and Tyra West. Tied into the centre are 5 unmanned satellites; Tyra Southeast, Harald, Valdemar, Svend and Roar.

The two existing gas processing and accommodation platforms on Tyra East and Tyra West will be replaced by one new procwessing platform and one new accommodation platform.

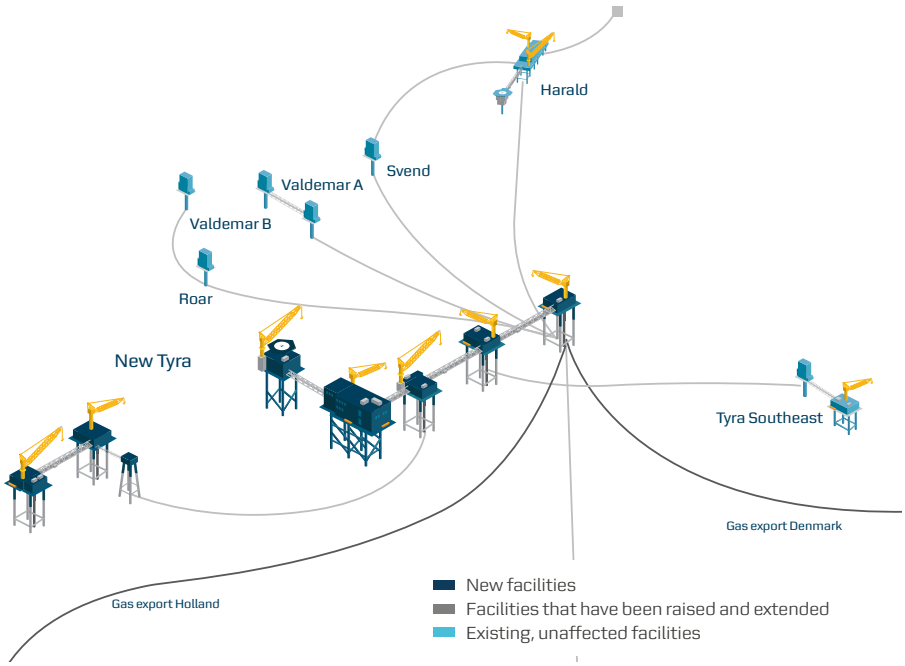
The four well head platforms and two riser platforms will have their jackets extended by 10 metres. The current topsides will be replaced by new topsides.

The unmanned satellite platforms in the area have not been affected by subsidence, and will therefore not be redeveloped. Production from the satellites will be temporarily stopped during the redevelopment.

Production from Tyra is expected to temporarily shut-in in November 2019 to enable the removal, renovation and redevelopment of the facilties.

Once redevelopment has been completed in 2022, Tyra will once again play an important role in the reliable and secure supply of gas to Denmark.

The future Tyra area



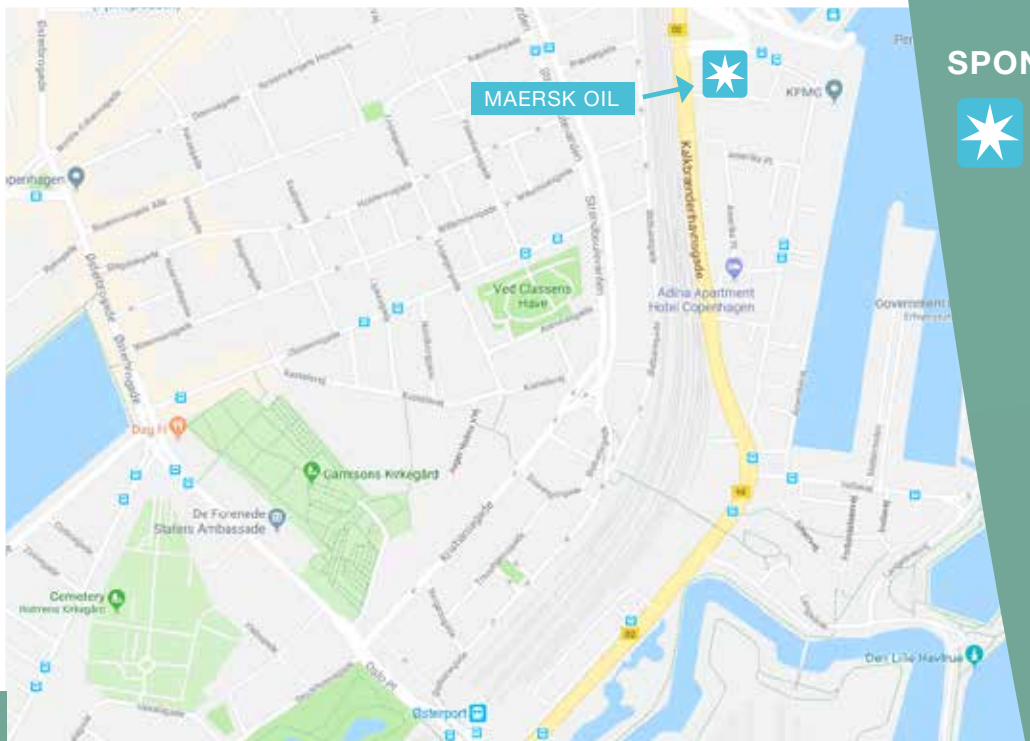
BIOGRAPHY

Morten Hesselager Pedersen, Maersk Oil

Morten joined Maersk Oil in 1997 as Well Site Engineer and spent his first 4 years offshore on drilling rigs and stimulation vessels. In 2002 he transferred to Qatar and spent the majority of the next 8 years working on the Al Shaheen Field as Reservoir Engineer. In 2010 Morten was transferred to Houston as Project Manager for non-operated deep water assets in the Gulf of Mexico. After two years in the United States, Morten was transferred back to Qatar and appointed Project Manager for Field Development Plan FDP2012, a USD 1.5 billion project comprising around 50 development wells, pipeline installation and various facility modification scopes. Most recently Morten has worked in the Danish Business Unit, initially as Asset Manager for the Tyra Asset and currently as Vice President and Head of the redevelopment of Tyra.

Niels Jensen, Maersk Oil

Niels joined Maersk Oil in 1995 as Mechanical Engineer in the Danish Business Unit. In 2001 Niels was appointed head of the Mechanical team in Engineering and was responsible for a portfolio of brownfield projects as well as FEED for a number of Development Projects. In 2005 Niels was appointed Project Manager for the Halfdan Northeast Development, a fast track gas development project in the Danish North. In 2008 Niels transferred to Aberdeen as Project Director for the Dumbarton Phase II, Lochranza and North Gryphon developments. In 2010 Niels transferred back to the Danish Business Unit, initially as head of the Tyra Facilities Optimization Project, a major brownfield project, and currently as Project Manager on the redevelopment of Tyra.



COPENHAGEN
MEETING
WEDNESDAY 28 FEBRUARY 2018

FEBRUARY

PROGRAMME
17:00 - 18:00
DRINKS

18:00 - 19:00
PRESENTATION AND SPE NEWS

19:00 - 21:00
DINNER

LOCATION
Maersk Oil
Amerika Plads 29
2100 København Ø

SPEAKERS
Niels Jensen & Morten Hesselager Pedersen, Maersk Oil

TOPIC
The Tyra Future project

ENTRANCE FEE
None

REGISTRATION
Please indicate your attendance by Friday 23 February 2018 by signing up on the internet **www.spe-cph.dk**
Registration required - will be checked upon arrival.

SPONSOR
MAERSK OIL

SPE COPENHAGEN SECTION
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SPE MEETING SCHEDULE 2017-2018

October 9	MAIN SPEAKER	AFTER DINNER
TOPIC	**Developing a Proactive Late Life Asset Mindset & Decision-Based Roadmap**	Partnering for performance *Lee Hodder, VP Demark Shell*
SPEAKER	Odin Estensen, Shell	
LOCATION	Charlottehaven	
SPONSOR	Shell	
November 21	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**Fluid flow simulation in fractured reservoirs Influence of Porous Media on fluid PVT**	Industry-academia research collaboration – how can we make this work for the benefit *vas von Solms, DHRTC–CERE*
SPEAKER	Hamid Nick, DHRTC, Wei Yan, CERE	
LOCATION	DTU	
SPONSOR	DTU	
December 5	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**Essential Pre-Requisites for Maximizing Success from Big Data**	
SPEAKER	Muhammad Khakwani (SPE DL)	
LOCATION	GEUS	
SPONSOR	GEUS	
January 24	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**Surviving Lower for Longer Prices with Lean Thinking**	Applying Lean *Agustin Riccio-Rodriguez, Hess*
SPEAKER	Gregg Stocker, Hess LEAN Advisor	
LOCATION	Moltke's Palæ	
SPONSOR	HESS	
February 28	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**Tyra Future**	
SPEAKER	Niels Jensen & Morten Hesselager Pedersen, Maersk Oil	
LOCATION	Maersk (Amerika Plads)	
SPONSOR	Maersk	
March 22	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**Integrated Historical Data Workflow: Maximizing the Value of a Mature Asset**	
SPEAKER	Anne Valentine (SPE DL)	
LOCATION	Welltec	
SPONSOR	Welltec	
April	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC		
SPEAKER		
LOCATION	INEOS	
SPONSOR	INEOS	
May 15	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC		AGM
SPEAKER		
LOCATION	Charlottehaven	
SPONSOR	Chevron	
June	**MAIN SPEAKER**	**AFTER DINNER**
TOPIC	**SPE Summer party**	
SPEAKER		
LOCATION		
SPONSOR	Schlumberger	

SPE Young Professionals

Please join the SPE Young Professionals meeting 20th of March from 5-7 PM. Venue to be announced. The meeting will focus on Advanced Analytics incl. topics such as corrosion management and predictive maintenance.

Cemre Yigen is a senior management consultant at Accenture and has worked 6 years in the Oil & Gas industry. He has 2 years of experience as a management consultant and 4 years as project engineer. In his work, he focuses on data analytics, automation and digitalization to deliver process transformations and business optimization projects.

Cemre holds an M.Sc. In Mechatronics Control Engineering from Aalborg University and has participated in an exchange program at the University of Illinois at Urbana-Champaign. He has graduated from the two-year Maersk International Technology And Science program where he had exposure to technical challenges in the Oil & Gas industry while developing a business mindset. ◄

MAXIMISING MATUR

WITH ADVANCED WELL COMPLETION AND

Maximizing the sweep efficiency and economical recovery from mature fields requires strong cross-disciplinary integration of all available information. Understanding the reservoir requirements is critical for selecting the optimum reservoir management strategy and taking the right well decisions. Often conventional thinking needs to be challenged to find the most cost-efficient solutions.

For over 20 years, Welltec® has continued to grow an ever expanding portfolio of innovative solutions to address well challenges and in recent years, this innovation has focused more and more on the successful integration of both interventions and completions solutions. In particular, for mature field recovery where late life re-completions, re-drilling or in-fill drilling is key, the lower completion Flex-Well® is an example of how a technology adoption can provide solutions to different mature field challenges.

Construction of new wells in mature reservoirs with un-even pressure depletion and sweep can create challenges to operational safety. Running the well completion with optimized barriers in place is critical and the innovative Flex-Well® design provides a unique solution. The construction is conducted with a pressure-containing liner whilst metal expandable WAB® packers provide efficient cement assurance and isolation against shallow gas.

WATER MANAGEMENT

Water management is often critical to maximize the ultimate oil recovery and extend the economic life of mature fields. Maximizing the sweep of the lower permeable rock is essential and efficient inflow control on separate high permeable reservoir units or zones along horizontal wells can result in large recoverable gains.

To meet these water management requirements, the Flex-Well® provides the option of multiple zones isolated by Welltec's robust metal expandable packers (WAB®) installed according to geology and controlled by flow valves (WFV®).

When a water flood is mature or water encroachment is progressed a different approach to the reservoir management strategy may also be required. Reducing the drawdown on new infill wells is a potential advantage and for this the Flex-Well® provides a clear solution. Compared to other conventional completions, the ability to run un-cemented liners leads to improved reservoir connectivity and the well can deliver the same production volume at a lower drawdown and minimized water cut.

Commonly performed water management activities on Welltec® wireline tractors are: shifting sleeves, opening or closing valves, and setting internal patches or plugs.

EXTENDED REACH IN HORIZONTAL WELLS

Tight fields with water flooding are often developed with long horizontal wells where conventional gravity assisted conveyance methods of interventions platforms reach their limit. Since inventing and launching the first tractor in the early nineties Welltec® has continued to build one

E FIELD VALUE
INTERVENTION SOLUTIONS

of the most extensive portfolio of wireline tractors in the industry. These tractors are used today in mature fields around the world in wells depths beyond 30,000 ft MD and in a variety of challenging HPHT environments.

SOLUTIONS SUPPORTING ACCELERATED AND SUSTAINABLE PRODUCTION

Fast construction time of new wells is critical in mature fields to support sustainable production and injection. The Flex-Well® lower completion is designed to accelerate initial production or injection as it can be run on a single liner run followed by WAB® packers expanding, and sealing, within minutes.

Sustaining long-term sweep efficiency and economic recovery through a field life of 30 maybe 40 years furthermore requires continued well maintenance. Wells grow old and in wells where access has become an issue, clean-out solutions can help to regain access and improve production, while milling and fishing can remove difficult obstructions.

The Welltec® powered mechanical intervention solutions, run in conjunction with the well tractor family, is one of the most comprehensive solution platforms available today in a vast range of sizes to cover all downhole environments and well restrictions that are typically associated with mature fields.

The solutions are designed to assist with:

- Removal of wax, scale, salt, paraffin, hydrates, glass, cement, shale, sand, rubber, mud solids, debris, and clay
- Milling of glass plugs, nipples, seat profiles, plugs and valves
- Induced fracture and completion cleaning
- Formation drilling
- Casing cutting
- Enlargement of buckled tubing

REMOVAL OF SEVERE BARIUM SULPHATE SCALE DEPOSITION

Reservoir management strategies like injection of seawater to improve secondary recovery can create severe issues over time. The combination of sea water and formation water can create problematic barium sulphate scale deposits within wells and facilities which then require removal through interventions.

► *Continues at page 10*

An example of such an intervention was performed last year for a mature gas producer offshore UK. Barium sulphate scale had built-up from the tubing hanger and was preventing the removal of the WR-SCSSV which was failing to close and required a change-out. In addition, the LMMV bonnet and stem required a changed-out with 2 plugs required. In addition, a tubing hanger ID restriction (3.9") limited the available milling bit options (WR-SCSSV No-Go 3.86").

In order to meet the demands of the operation, a 3.88"OD tapered milling bit was manufactured to comply with the 4.1" well ID restrictions and size of replacement sleeve. The deployed tool strings including the tapered milling bit and 2 release devices were run with the Well Tractor®. An additional run was also made with an expandable milling bit with 3-1/8" OD in closed position which finally succeeded in removing the barium sulphate scale and reached the WR-SCSSV depth, which was confirmed on surface by the current draw down witnessed and milling response observed.

With the scale successfully milled from below the tubing hanger to the WR-SCSSV, the safety valve and LMMV were then changed as planned.

Operator statement: "The Expandable bit was the key to opening up a path through the scale to allow us to pull the safety valve. Just so you know the new valve is installed & tested. It has taken us 3 years to get to this point with numerous unsuccessful interventions, the alternative was coiled tubing or possibly a workover. Needless to say, there are a few happy faces"

AUTOMATION MINIMISES THE RESPONSE TIME for OPERATIONS

With fields maturing around the world the focus on building maintenance and intervention programs is increasing. Interventions procedures are well defined but the exact intervention requirement is hard to define before operations investigate the specific well challenges.

Welltec® understands the importance of improved well uptime and fast response to requests from the operators. In 2015 Welltec® introduced advanced robotic automation in the manufacturing of interventions and completions technologies with the ambition to reduce costs, reduce lead times, increase delivery performance and continuously strengthen R&D initiatives.

With our robots now in full force, the company has been able to cut down on manufacturing time, allowing faster response time to job requests from the oil industry and enabling case studies such as the one outlined above where custom made solutions can be rapidly deployed into the field with short notice.

An achievement not only recognized by the industry but also resulting in Welltec® being awarded with the automation prize by DIRA (the Danish Robotics Network) in 2016.

ABSTRACT

INTEGRATED HISTORICAL DATA WORKFLOW: MAXIMISING THE VALUE OF A MATURE ASSET

Industry studies show that mature fields currently account for over 70 % of the world's oil and gas production. Increasing production rates and ultimate recovery in these fields in order to maintain profitable operations, without increasing costs, is a common challenge.

This lecture addresses techniques to extract maximum value from historical production data using quick workflows based on common sense. Extensive in-depth reservoir studies are obviously very valuable, but not all situations require these, particularly in the case of brown fields where the cost of the study may outweigh the benefits of the resulting recommendations. This lecture presents workflows based on Continuous Improvement/LEAN methodology which are flexible enough to apply to any mature asset for short and long-term planning. A well published, low permeability brown oil field was selected to retroactively demonstrate the workflows, as it had an evident workover campaign in late 2010 with subsequent production increase. Using data as of mid-2010, approximately 40 wells were identified as under-performing due to formation damage or water production problems, based on three days of analyses. The actual performance of the field three years later was then revealed along with the actual interventions performed. The selection of wells is compared to the selection suggested by the workflow, and the results of the interventions are shown. The field's projected recovery factor was increased by 5%, representing a gain of 1.4 million barrels of oil.

BIOGRAPHY

SPE DL Anne Valentine - Principal Instructor for Production Engineering at Schlumberger.

Anne has 35 years of experience in Canada and France in well and reservoir performance analysis, particularly related to waterflooding, unconventional reservoirs and candidate recognition for production enhancement. She built her expertise in performance analysis workflows and software through working on the Cold Lake heavy oil field as a reservoir and field engineer at Esso Resources Canada Limited, then consulting for Halliburton before joining Schlumberger in 2001. A graduate in Chemical Engineering from Queen's University in Canada, she has co-authored papers on analysis techniques for polymer floods, waterflood optimization and shale gas forecasting.

COPENHAGEN MEETING

THURSDAY 22 MARCH 2018

MARCH

PROGRAMME

17:00 - 17:30
DRINKS

17:30 – 18:15
GUIDED TOUR THROUGH THE MANUFACTURING FACILITIES

18:15 – 19:15
PRESENTATION

19:15
DINNER

LOCATION

Welltec
Gydevang 25
3450 Allerød

SPEAKER

SPE DL Anne Valentine, Schlumberger

TOPIC

Integrated historical data workflow:
Maximising the value of a mature asset

ENTRANCE FEE

None

REGISTRATION

Please indicate your attendance by
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Maersk Oil has a proven track record of making the impossible possible through deployment of integrated technical solutions and profitable field development.

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