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SOCIETY OF PETROLEUM ENGINEERS

SPE NEWS

COPENHAGEN SECTION

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WHAT A CROWD!

Almost 3 months has passed since the last Newsletter, and we have had 2 very successful meetings since then. Let me start by thanking Chevron and DONG Energy for sponsoring the events. Without the support from the local companies and the community, SPE Copenhagen would not exist, and I am excited to see how many attendants we have at all our meetings. Even, when you are asked to go 20 km North of Copenhagen to the DONG offices, we are capable of getting close to 100 people. Impressive!

The main speaker at the January meeting, Ole Dalgaard, took us through the Svane discovery. A truly promising discovery with a large potential, but also with challenges. The extreme temperatures and pressures found in Svane is just at the brink of what to-days technology can handle; it exemplifies the fact that in a mature area as the North Sea, technology development is important whether it is for extreme conditions or optimization for brown fields. During the Dinner, Kelly Taylor gave us a short insight in the Mature Asset management strategy used in DONG Norway.

Before Christmas Marco Thiele from Stanford presented the latest developments of streamline simulations, and pointed for example towards the strength of streamlines for managing Water Flooding projects. The Dinner speaker of the day Linda van Bol from Chevron presented the Britannica field case, where she demonstrated that continuous drilling for more production may not always be the right decision.

In February, Welltec will sponsor our meeting. The main speaker is Morten Iversen who will discuss "Current effects on Cable in Open Water". During the dinner, Asger Johansen our SPE bursary recipient will give us insights into his project on AVO inversion.

Our March meeting is hosted by Maersk, and I am really looking forward to hear Jennifer Julian, BP, talking about "Twenty Years of Wellwork". During the dinner Maersk will present one of the internal development projects within the Geophysical realm.

Lastly, please remember to reserve the 15 June for the SPE Summer party. This will be a very interesting venue, where we look forward to welcome you and your spouse.

Morten G. Stage, ***Section Chairman*** ◄



FUTURE MEETINGS

FOR MORE INFORMATION REGARDING THE PROGRAMME SEE PAGE 6

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COPENHAGEN SECTION

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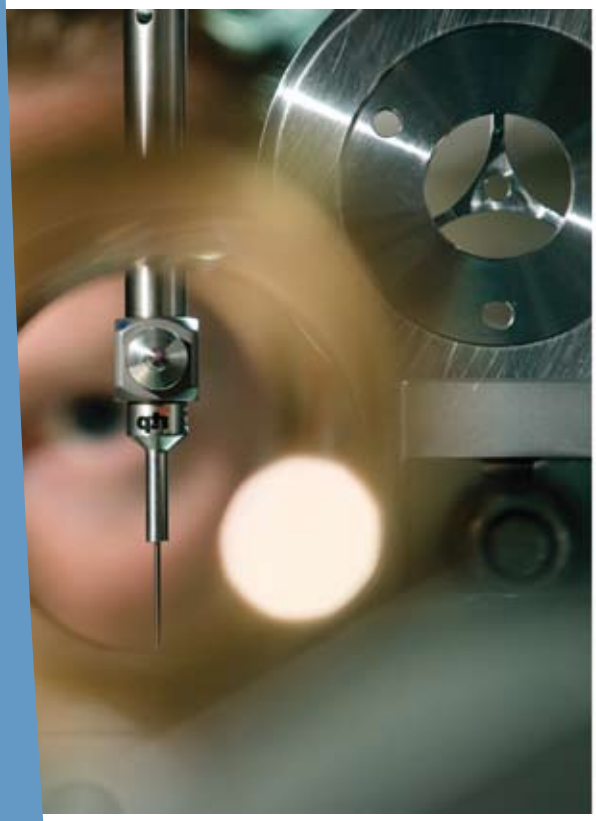
Welltec®, Innovation Is





Several decades ago, as horizontal drilling first began to make its appearance in the North Sea, there was a company which had a vision; an innovative, entrepreneurial vision that saw a world one day dominated by these new, horizontal wells. Currently, with over 50% of the world's rigs drilling horizontally, that vision is fast becoming a reality. The year was 1994 and the company was Welltec®.

Being innovative was what the marketplace needed and Welltec® has seen many of its novel ideas become reality. Innovation is our nature and we are still full of visionary ideas to pursue further. As technology improves, opportunities exist for ever-increasing capabilities and dreams of what might be. The primary driver behind this vision is focused on how to do things better - how to do it



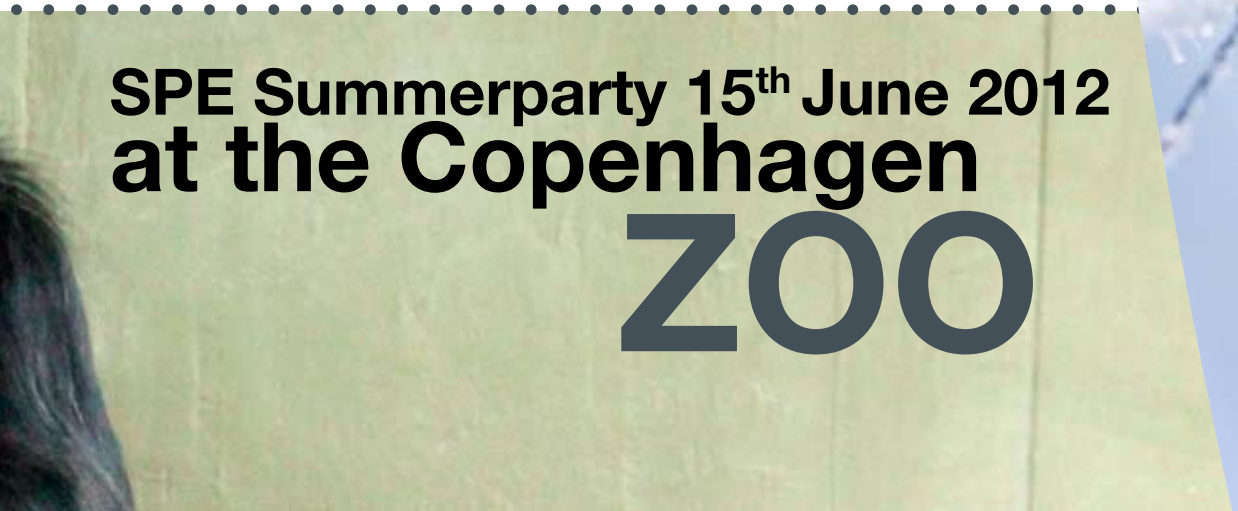
our Nature





more safely, how to do it more effectively, how to do it more efficiently. For Welltec® and our clients, this translates into a suite of technology which allows operators to manage their wells and reservoirs in a much more economically efficient way.

Welltec's vision is to develop technology that furthers the ability to modify and change the well over time through interventions; eventually even autonomous interventions. The result, a 'Flexible Well' which provides improved production management with lower upfront capital expenditure, lower operating expenditure, higher return on invested capital and higher recovery rates. This paradigm shift involves the entire well life cycle and has far reaching impact on the way oil and gas can be produced by enabling optimal reservoir exploitation.



SPE Summerparty 15th June 2012
at the Copenhagen
ZOO

ABSTRACT

Current Effect on Cable in Open Water, Challenges and Solutions

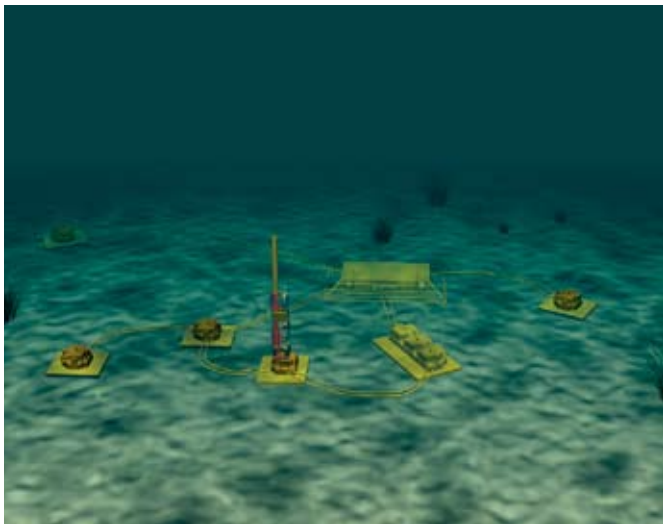
During offshore well interventions, the wireline is exposed to the currents in the open water between the ship and the subsea lubricator system. The drag and lift forces acting upon the exposed length of wireline can deflect the wireline significantly from a straight line between the ship and the wellhead. This deflection makes it challenging to acquire accurate depth readings from the winch. It also makes it necessary to carefully assess the magnitude of the forces, which will act on the wireline, in the job-planning phase.

The forces which cause the deflection of the wireline will, through the internal forces in the wireline, effectively act with a non-negligible upward force on the toolstring inside the well. In extreme cases, the force of the current on the wireline will be able to break it. In less extreme cases, the force will be strong enough to pull the toolstring out of the well.

Welltec®, having firsthand knowledge of these issues, from the world record RLWI depth of 905 meter, has started a program to further expand the Well simulation Software (WellSim™) to also include the effect of open water.

The simulation will be based in a discretized model of the wireline. The wireline is divided into N cylindrical sections of constant mass and variable length. From basic dynamics, a second order differential equation in 3N variables can be derived. This is equivalent to a first order system in 6N variables. Looking for an equilibrium solution for the system, the overdamped case can be used. This leads to a reduction to a first order differential equation in 3N variables. Solving the equations, using a standard Runge-Kutta method, the shape of the wireline and the internal forces along the entire wireline can be calculated.

The force terms on the equations comes from the lift and drag forces induced by the current on each wireline section, as well as the gravity, buoyancy and internal forces in the wireline.



Given a current profile and the water density as function of depth, the internal forces of the wireline and the upward force, exerted by the wireline at the top of the lubricator, can thus be calculated. Based on the results of the simulation, a job can be planned such that the gravity on the toolstring can overcome the upward force from the wireline and the wireline tension is kept within a safe envelope. ◄

BIOGRAPHY

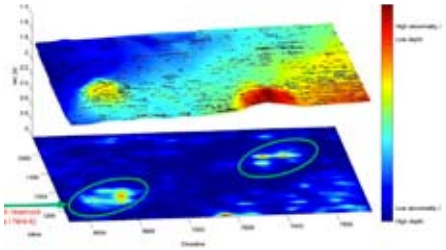


Biography, Morten Iversen
Solution Advisor, Global Subsea Intervention

Mr. Morten Iversen is trained as a Petroleum Engineer and has more then 30 years of experience working in the oil industry working primarily with well completion projects and well services. He has been responsible for numerous well completion projects worldwide and has similarly built up vast experience on well intervention. Not least by contributing to the pioneering work behind the concept of riserless light well intervention. A concept he as, Solution Advisor, Globa Subsea Intervention, Welltec, is pursing and refining. ◄

Predicting hydrocarbons and the properties of North Sea greensand

The presentation aims at presenting the work of my master thesis in Petroleum Engineering concerning AVO inversion and rock physics based AVO inversion. The case study is based on well log and seismic data from the Nini field in the Danish part of the North Sea. Through a well log interpretation the greensand reservoirs are identified and the AVO (Amplitude variation versus offset) response of greensand is investigated. From these results a method, based on the principles on AVO analysis, is developed to identify possible oil reserves from the seismic data covering an area of about 7.5 km2. While the method is verified by identifying the known oil reservoirs observed from the Nini well log data, the method also identifies another possible oil reservoir, which might be of economical interest. This concern is partly investigated by the second part of the thesis based on AVO inversion.



Combining rock physics with seismic AVO inversion is a promising and not yet fully covered field of seismic exploration. By inferring a rock physics relation in the seismic inversion it might be possible to verify the oil in place by information obtained on petrophysical properties, ie. porosity and oil saturation, important to field evaluation. The prospects of predicting these properties are investigated by incorporating a rock physics model in the non-linear waveform inversion. This inversion model is applied to seismic data from a location, of which the elastic and petrophysical properties of the oil saturated greensand are known, but also to the seismic data of the other possible reservoir identified, shown at the figure.

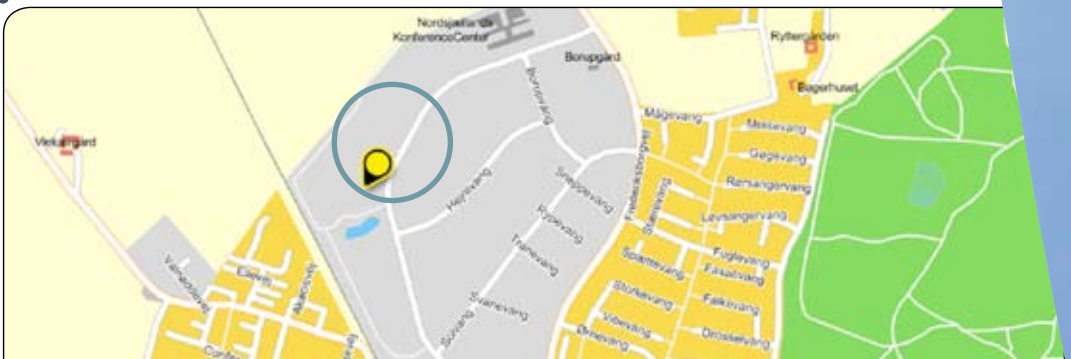
The figure shows the location of the possible oil reservoirs from an inspection of where the seismic data is found to have an AVO response, which is likely to be caused by change in pore fluid. The contour surface represents the Ekofisk formation while the black dots show the location of the identified seismic anomalies. The bottom 2D map expresses the magnitude of the abnormality.

BIOGRAPHY



Asger Johansen, Technical University of Denmark

Asger Johansen studies at the Technical University of Denmark writing his master thesis in Petroleum Engineering to graduate mid April. He has a bachelor in Mechanical engineering and has worked with change management and inventory systems in Dong Energy (2008-2010) concerning spare parts management to the Siri platform in the North Sea. The focus of his master studies has primarily been on rock physics and seismic exploration.



COPENHAGEN
MEETING
TUESDAY 28 FEBRUARY 2012

FEBRUARY

PROGRAMME
17:00 - 18:00
Drinks

18:00 - 19:00
Presentation and SPE News

19:00 - 21:00
Dinner

LOCATION
Welltec A/S
Gydevang 25
DK-3450 Alleroed

SPEAKER
Morten Iversen
Solutions Advisor, Welltec

TOPIC
Current Effects on Cable in Open Water

DINNER SPEAKER
Asger Johansen
DTU

TOPIC
AVO analysis and rock physics based AVO inversion - Predicting hydrocarbons and the properties of North sea greensand

ENTRANCE FEE
None

REGISTRATION
Please indicate your attendance by Thursday 23 February by signing up on the internet www.spe-cph.dk

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SPE MEETING SCHEDULE 2011-2012

September 22	MAIN SPEAKER	AFTER DINNER
TOPIC	**E&P Applications of Fiber Optic Technologies**	The Subsea Well Response Project
SPEAKER	Dennis Dria (Myden Energy Consulting PLLC)	Klaas van der Plas (Shell)
LOCATION	Moltkes Palæ	
SPONSOR	SHELL	

October 10	MAIN SPEAKER	AFTER DINNER
TOPIC	**Mechanical Properties of High-Porosity, Low-Cemented Chalk from Survey on Laboratory Results. History matching method combined with geostatistics. Formation damage—an old disaster or a new EOR technology.**	Impact of microbes in oil fields and oil production
SPEAKER	Katrine Andreassen, Yulia Melnikova, Hao Yuan	Ketil Sørensen (DTI)
LOCATION	DTU	POSTPONED TO APRIL
SPONSOR	DTU	

November 22	MAIN SPEAKER	DINNER SPEAKER
TOPIC	**Streamlines in Modern Reservoir Engineering**	Britannia – Recovery Improvement through Field Life Reservoir Management
SPEAKER	Marco R. Thiele (Streamsim Technologies/Stanford University)	Linda van der Bol (Chevron)
LOCATION	Moltkes Palæ	
SPONSOR	Chevron	

January 18	MAIN SPEAKER	AFTER DINNER
TOPIC	**Svane - extreme HPHT gas - a resource for the future?**	Uncertainty and Risk Management for Lifecycle Asset Management Using Examples from the Norwegian and Danish Sectors of the North Sea
SPEAKER	Ole Dalgaard (DONG E&P)	Kelly Tyler (DONG E&P)
LOCATION	DONG Energy	
SPONSOR	DONG Energy	

February 28	MAIN SPEAKER	DINNER SPEAKER / DISCUSSION
TOPIC	**Current Effects on Cable in Open Water**	AVO analysis and rock physics based AVO inversion - Predicting hydrocarbons and the properties of North sea greensand
SPEAKER	Morten Iversen	Asger Johansen
LOCATION	Welltec	(recipient of SPE bursary 2011)
SPONSOR	Welltec	

March 20	MAIN SPEAKER	DINNER SPEAKER
TOPIC	**Twenty Years of Wellwork - Interventions and Innovations at Prudhoe Bay Alaska**	Seismic inversion: turning data into information
SPEAKER	Jennifer Julian (BP Exploration, Alaska)	Igor Escobar, Adam Cherrett (Maersk)
LOCATION	Maersk	
SPONSOR	Maersk	

April 17	MAIN SPEAKER	ANNUAL MEETING
TOPIC	**Greenland exploration potential**	Impact of microbes in oil fields and oil production
SPEAKER	TBA	Ketil Sørensen (DTI)
LOCATION	GEUS	
SPONSOR	GEUS	

May 10	MAIN SPEAKER	ANNUAL MEETING
TOPIC	**Two Consecutive 4D Seismic Surveys at South Arne Impact Field Development**	Annual General Meeting
SPEAKER	Kim Hansen and Ole Vejbæk (Hess)	
LOCATION	Moltkes Palæ	
SPONSOR	HESS	

June	MAIN SPEAKER	DINNER SPEAKER
TOPIC	**SPE Summerparty**	
SPEAKER		
LOCATION		
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MAERSK OIL unlocks value with cle

Maersk Oil is exploring a host of business opportunities with its rights to a novel power generation technology that can provide commercial solutions to enable enhanced oil recovery and unlock decades-old stranded gas fields.

TriGen is a power generator the size of a Maersk shipping container which burns gas with pure oxygen to produce power, water and carbon dioxide. The resulting high purity CO_2 is captured, making the power generation emission-free, and can be transported to fields for Enhanced Oil or Gas Recovery (EOR/EGR).



It was the EOR application that first caught the eye of Maersk Oil, which had already started to study whether it could use CO_2 to enhance recovery from its own mature oil fields and was seeking low cost sources of the gas.

But the company soon realised that the technology's multi-stream output, including its ability to burn CO_2-contaminated gas as fuel without any pre-treatment, actually gave it access a number of business opportunities around the world.

"We're currently exploring opportunities in the Middle East and South-East Asia that have different value chains and benefits, yet both can now be made commercial from the implementation of the TriGen technology," said Bob Alford, TriGen Project Manager.

In the Middle East, Maersk Oil is investigating whether TriGen's low cost CO_2 can enable EOR projects. Gulf countries in particular have increasingly focused on clean energy, while many of their oil and gas reservoirs are suited for CO_2-EOR and nitrogen or CO_2 based EGR.

Here, gas would be burned to produce clean power and water for households. Nitrogen, a by-product from the production of pure oxygen, and CO_2 would be supplied to oil fields – nitrogen to maintain the pressure in depleting reservoirs and CO_2 as the EOR agent coaxing out oil that would otherwise not be recovered.

Traditionally, CO_2-based EOR has only been feasible in areas with large sources of natural CO_2 – chiefly in the United States. But the ability to produce CO_2 as a by product of a commercial venture now makes CO_2-based EOR attractive in regions such as the Middle East, which has limited sources of natural CO_2.

"The technology provides Maersk Oil a competitive advantage in the Gulf region as it offers both the benefit of clean power and low-cost CO_2 to increase recovery potential. The technology also complements Maersk Oil's current work and studies on CO_2-based EOR in Denmark and Qatar, enabling us to offer integrated field development solutions in this area," Alford said.

In South East Asia, the value chain starts at a different point – at world class gas fields that lie undeveloped because they are contaminated by CO_2. Such stranded gas fields could now potentially be produced economically because the TriGen

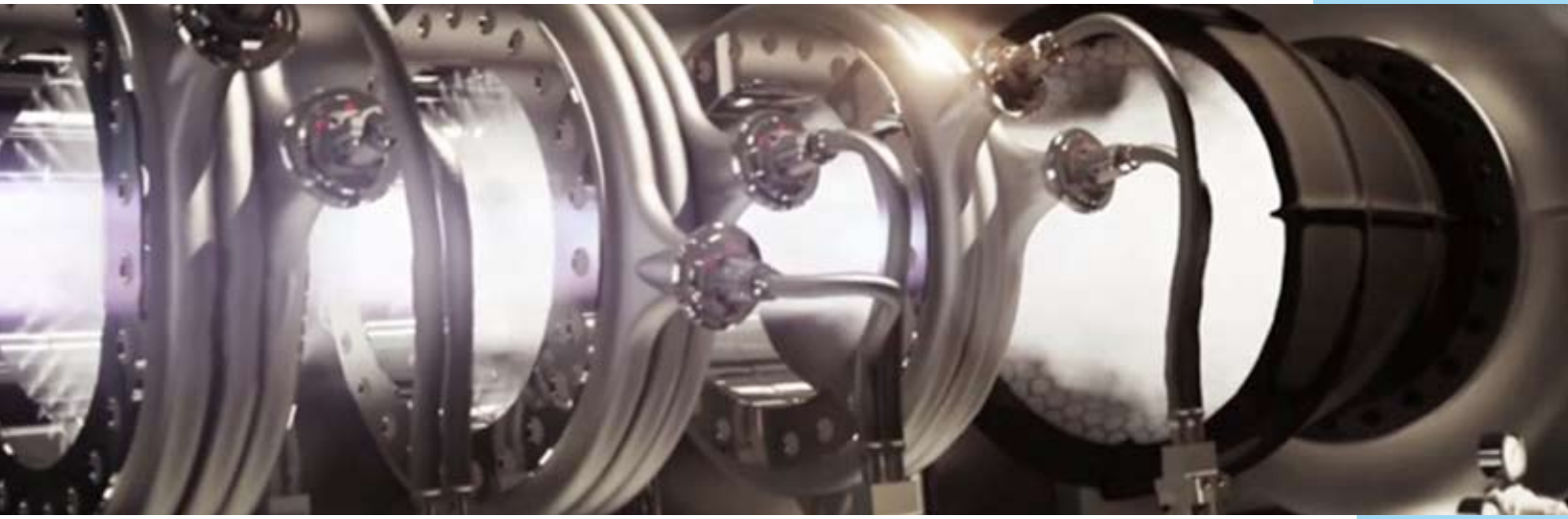
an TriGen technology

technology can burn gas contaminated with up to 90% of CO_2 without requiring any costly pre-treatment for CO_2 removal.

"We would be unlocking enormous value to the states that have been sitting on these fields, unable to produce them commercially," Alford said. "Although it is early days yet – there are technical and commercial challenges to overcome – these are just the kind of projects that affirm Maersk Oil's pioneering approach to business."

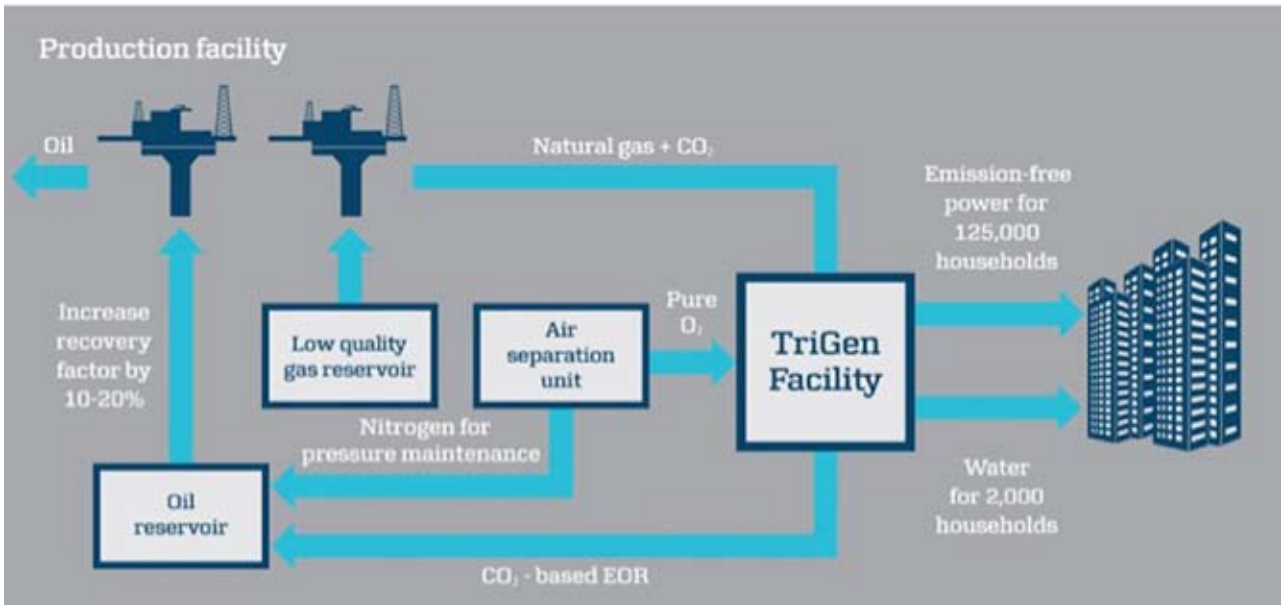
Derived from rocket science, where pure oxygen is used to burn fuel, CES has proven the technology on a smaller scale over the last 15 years.

Siemens is currently converting a conventional gas/air turbine to a gas/oxygen turbine for a commercial power plant project in California using the TriGen technology.



Maersk Oil launched the project two years ago and in January 2011 it announced the acquisition of rights to the combustion technology from U.S.-based Clean Energy Systems (CES). CES, in collaboration with Maersk Oil, Siemens and the U.S. Department of Energy, is maturing the technology.

The converted turbine will be hooked up to a power grid in North Los Angeles next year and has the capacity to deliver 150 Megawatts of electricity – enough to provide energy to over 100,000 homes.



ABSTRACT

TWENTY YEARS OF WELLWORK:

Interventions and Innovations at Prudhoe Bay, Alaska

Prudhoe Bay, with its long history of innovative wellwork intervention advances, continues to push the limits of wellwork technology as its wells become increasingly mature and complex. Developing cutting edge technologies is the key to ensuring safe, environmentally sound and economic recovery of mature oil wells, but how is this done successfully?

Well integrity is foremost on everyone's mind and innovative well integrity diagnostics at Prudhoe Bay include revolutionary ultrasonic leak-detection logs to identify ultra-small leaks. Fiber-optic distributed temperature surveys that measure real-time temperature along the entire wellbore have also been used successfully. Leak identification is just the first step to bringing a well back in service. Prudhoe Bay's advances in non-rig tubing repairs include innovative tubing straddles allowing inexpensive non-rig remediation for arctic, offshore and remote locations.



Coiled tubing (CT) holds the key for low-cost remote and offshore well interventions and Alaska is a leader in CT technology. It is a well-published fact that wells are being drilled that are deeper, further and harder to work on than at any other time in history. Though these wellbores are designed to be "interventionless," history suggests that, at some point in the life of the well, intervention will be required. Fiber optic coiled tubing, the marriage of CT and fiber optics, has become a key enabler for multilateral intervention at Prudhoe Bay.

With more than 4,000 well interventions per year, Prudhoe Bay has been, and continues to be, one of the leaders in wellwork technology. How were these new technologies implemented so successfully? The key is strong relationships with field personnel, strong economic justification and well-designed field trials. ◄

BIOGRAPHY



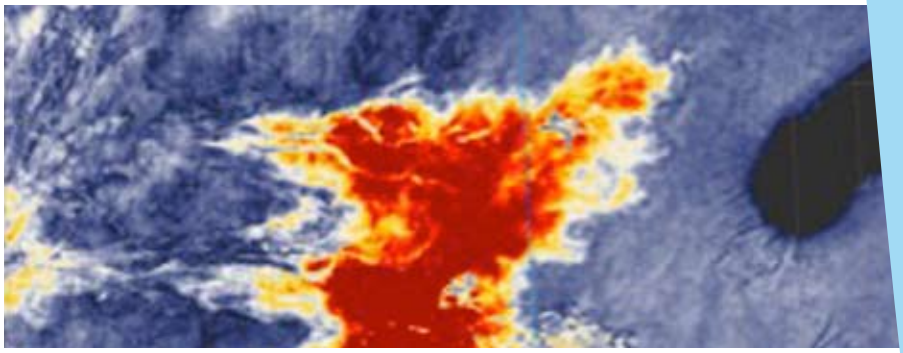
Jennifer Julian, BP Exploration, Alaska

Jennifer Julian is a Well Intervention Advisor for BP Alaska Consolidated Team. She is an expert in complex well interventions and is a recognized leader in advances in coiled tubing, tractor and well-integrity technology and non-rig remediation. Julian has been a major technical contributor to the success of Alaska's wellwork program for 20 years, including 6 years in the field. She has authored more than 15 papers on all facets of wellwork intervention and has received 9 technical achievement awards from Arco and BP in recognition of her contributions to the well intervention discipline. Julian was awarded the 2007 SPE Western North America Region Drilling & Completions Engineer Award, and 2007 Alaska Chapter SPE Engineer of the Year. She holds a BS in petroleum engineering. ◄

SEISMIC INVERSION:

Turning data into information

Geoscientists have a wide range of data types available to help characterise the subsurface. Individually, these data may not have sufficient coverage, accuracy or resolution to answer all the questions we may ask of them. Together, if combined in a practical and rigorous manner, they can yield an optimal model of the earth. This talk introduces the concepts underlying joint inversion, illustrating the power of this technique with a number of case studies. The inversion method combines observations in seismic experiments and at wells with estimates of their accuracy, transforming them into probabilistic estimates of elastic and rock properties. Joint inversion integrates prestack seismic data, well logs and geological interpretation, to avoid many of the potential pitfalls of classical amplitude-based techniques, and gives more detailed and reliable information on the subsurface. ◄



BIOGRAPHY



Igor Escobar and Adam Cherrett, Maersk Oil

Adam Cherrett has a PhD in Geophysics from the University of Cambridge, and Igor Escobar an MSc in Petroleum Geophysics from Imperial College. They have both worked in the Total Geoscience Research Centre UK and their Technical and Scientific Centre in France before joining Maersk Oil's corporate quantitative interpretation team. Igor and Adam have worked for many years in reservoir geophysics, and have published articles on topics including seismic inversion, geomechanics, rock physics, 4D seismic, anisotropy and depth imaging. ◄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THE INTERVENTION IN RLWI



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Maersk Oil is a global operator producing some 700,000 barrels of oil equivalent per day. We turn opportunities into reality by continuously improving our technical capabilities and developing new innovative solutions.



With operations and activities in several locations such as the North Sea, Qatar, Brazil, Algeria, Angola, Kazakhstan and the US Gulf of Mexico, Maersk Oil aims to serve its many stakeholders by operating safely and efficiently.

The career opportunities we offer are as diverse as our geographical spread making a powerful proposition for professionals who wish to be at the forefront of the oil and gas industry.

At Maersk Oil we foster a creative environment where employees are empowered to develop solutions to highly technical and complex challenges.

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