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SPE International
London Section

SPEREVIEW LONDON

- Fracture Simulation Parameters: Petrophysical Perspective
- Can the UK become a World Leader in CCUS?
- SPE London Young Professionals' Learning Opportunities
- PLUS: Events, Jobs

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ABOUT US
The Society of Petroleum Engineers (SPE) is a not-for-profit professional association whose members are engaged in energy resources, development and production. SPE serves more than 143,000 members in 141 countries worldwide. SPE is a key resource for technical knowledge related to the oil and gas exploration and production industry and provides services through its global events, publications, events, training courses and online resources at www.spe.org, as well as local chapters such as the SPE London section.
SPE London section publishes SPE Review London an online newsletter, 10 times a year, which is digitally sent to its 3000+ members. If you have read this issue and would like to join the SPE and receive your own copy of SPE Review London, as well as many other benefits – or you know a friend or colleague who would like to join – please visit www.spe.org for an application form.

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Information

At SPE Review London, we strive to provide knowledge and information to navigate our changing, and challenging, industry. We trust the June 2018 issue of SPE Review London will be useful, actionable and informative.

In the first of this issue's two technical features, '**Fracture Simulation Parameters, a Petrophysical Perspective**', **Fred Jenson, Product Strategy Manager Petrophysics and Geomechanics, CGG** discusses (*page 4*) the petrophysical parameters required as inputs for fracture simulation and how to generate those parameters.

The second of this issue's technical features **'Can the UK become a world leader in CCUS?'** starts on *page 8*. Nikki Brain, Policy Manager, Carbon Capture and Storage Association, provides an overview of her talk at the London Section evening meeting in May.

We continue to get some great responses for our new feature where we ask: **'What has SPE Done for Me?** In case you missed it the first time, read some insighful responses on *page 7*.

SPE London Young Professionals have been busy, with **learning opportunities at IHS Markit** (*page 3*) and a **visit to Abingdon Technology Centre**, the Schlumberger Centre of Excellence for Reservoir Engineering (*page 10*).

Our regular features include: Meet the people **'Behind the Scenes'**, The SPE Review Editorial Board (*page 3*) and the **SPE London Board** (*page 11*).

Make sure to keep up to date with **industry events and networking opportunities,** and the **Job Board** (thanks to Jared Hammond, Reservoir Engineer - Consultant, for providing the monthly job statistics)**,** all on *page 12*.

And don't forget to check out our social media pages: Facebook, Twitter, and Linkedin.

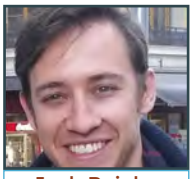
As always, this issue of SPE Review London offers the opportunity to be educated, entertained and informed.

https://www.spe-london.org/

Behind the Scenes: SPE Review Editorial Board

Jonathan Ovens
Chief Editor

- Ph.D in Physics at Cambridge University.
- Joined Shell in 1986. Reservoir Engineer – hydraulic fracturing, pressure transient analysis and reservoir simulation.
- 1997 - 2012: independent consultant covering the North Sea, North Africa and the Middle East.
- Experience ranges from Exploration and Development planning through to Reserves Evaluation.
- 2013: Senior Reservoir Engineer at JX Nippon E&P (UK) Ltd.
- 2009 and 2015 served with SPE Europec Technical Committee.
- Member of the SPE London Board.



Josh Beinke
Editor

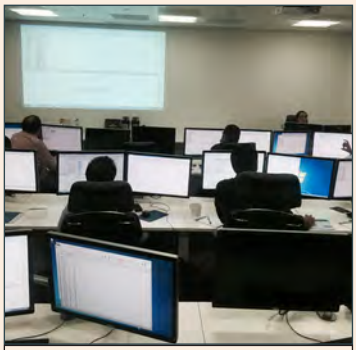
- Graduated from University of Adelaide with degree in Petroleum Engineering.
- 10 years prior experience with Chevron Corporation, Origin Energy and Santos, including as Production Engineer on the Gorgon Field during First Gas.
- Following move to Europe in 2016, consulted on European and African assets (specialising in data room and field development advisory).
- Now working out of Amsterdam as a Production/ Exploitation Engineer with Vermilion Energy.

Ffion Llwyd-Jones
Designer

- Editor and business writer, with 15+ years experience in North America and the UK.
- Editor for several trade and consumer magazines (print and/online).
- Provides industry-related case studies, and detailed, research-driven B2B reports and technical white papers.
- Accomplished photographer, and videographer.
- Educated in Canada, and in the UK.
- Fluent in Welsh and English.
- BA (Hons) from The Open University.

YP's Introduction to the Fundamentals of RTA

On Wednesday 20th of June, IHS Markit welcomed the London SPE Young Professionals to their offices at 25 Ropemaker Street for an Introduction to the Fundamentals of Rate Transient Analysis (RTA).



Concentrating on a session.

This event was an opportunity for attendees to learn about the fundamentals of modern techniques in RTA for the assessment of reserves and reservoir characterisation through the analysis of flowing rates and pressures.

The session was delivered by Silvia Rey Gomez, Associate Director for the IHS Markit Engineering Customer Solutions, and had an audience of young professionals from different backgrounds including petroleum engineers, reservoir engineers, production petro-physicists and financial analysts.

Silvia started the event with an introduction to the reservoir and production engineering software at IHS Markit and the different workflows that can be completed on them. After a coffee break, the RTA fundamentals sessions kicked off with topics such as the importance of using RTA, the end goal of RTA and the fully integrated approach of using traditional decline analysis, modern methods such as RTA and Well Test results when doing production data analysis.

The technical session took the attendees on a journey back to their university years, reviewing topics such as type curve diagnostics, traditional Arps decline analysis, transient and boundary dominated flow, the pesudo-steady state inflow equation, corrections for gas reservoirs and the principle behind flowing material balance. The attendees also enjoyed applying the concepts and analysing production data for different case studies using the IHS Markit engineering software.

The SPE YP – IHS Markit Technical day was fun and informal, yet well structured and very interesting. It answered the attendee's questions on RTA and it also covered an introduction to IHS Markit's RTA reservoir engineering software.

Fracture Simulation Parameters, a Petrophysical Perspective

Fred Jenson, Product Strategy Manager Petrophysics and Geomechanics, CGG, discusses the petrophysical parameters required as inputs for fracture simulation and how to generate those parameters.

Introduction

The fracturing of wells is a common procedure in the North American oil and gas industry and is becoming a standard way of improving production worldwide. The popularity of fracturing began with successful horizontal drilling in North American unconventional reservoirs, followed by extensive fracking of the North Texas Barnett Shale during the 1980s into the early 1990s. Much of this growth can be credited to the pioneering work of George Mitchell of Mitchell Energy in developing unconventional reservoirs.

In this paper we will discuss the petrophysical parameters required as inputs for fracture simulation and how to generate those parameters. Wells often do not have extensive logging programs that include many logs required for determining elastic properties for input to simulation packages, but there are numerous techniques for estimating these measurements when deterministic data is not present.

The Elements of Fracture Design

The key elements of fracture design can be summarised as:

- Detailed petrophysical analysis of the zone of interest
- Computation or estimation of elastic properties
- Determination of rock and fluid properties
- Interval averaging of log values for input into the simulator
- Parameter testing to ensure rock and fluid properties match well test results
- Transfer of rock and fluid properties into the simulator followed by a simulation run

Petrophysical evaluation determines the water saturation, porosity, permeability, clay volume, and lithology of the formation of interest. Of these, clay volume may garner the least attention and yet is the most important parameter for determining how a frack will propagate. Poisson's Ratio and Young's Modulus are required inputs for all fracture simulation packages, and there are a variety of ways to determine these elastic properties.

1. Deterministic computations where compressional sonic, shear sonic, and density curve are measured over the zone of interest
2. Computation of synthetic acoustics when DTS (shear acoustic log) and/or DTC (compressional acoustic log) are not acquired
3. Estimated from other logs in the well (RHOB, NPHI, DTC, GR, etc.) (Synthetic Curve Generation)
4. Generated using Deep Learning Models with Python Extensions (also using other curves)
5. Determined from a detailed rock physics model constructed over the zone of interest
6. Empirical equations for estimation of elastic properties when minimal logs are present

Mississippi Tight Gas Sands

The first example involves Lower Cretaceous sands in central Mississippi, the Cotton Valley formation (*Figure 1*).
These tight gas sands require fracture simulation to produce commercial quantities of gas from sands averaging about 10 – 12 percent porosity. A synthetic shear sonic was generated for the well of interest based on measured synthetics on nearby wells. The elastic properties as well as the post fracture tracer survey logs are displayed in *Figure 2*.
The well produced around 2 BCF from the blue perforations and it was estimated that another 2 – 3 BCF was producible. The red perforations were selected after multiple simulation models were run using elastic properties computed from curve data including synthetic shear sonic. Unfortunately, the operator divested this property before recompletion was scheduled.

West Texas Example

The Spraberry Wolfcamp shale play near Midland, Texas is now considered the second largest oil field in the world. *Figure 3* shows the petrophysical interpretation of a typical Spraberry Wolfcamp interval along with elastic properties and Biot's coefficient. These elastic properties were used to design optimum fracture models that were then provided to

Continued on page 5

Fracture Simulation Parameters... continued

the engineer who unfortunately used a different completion strategy (*Figure 4*).
The infamous "perforate and fracture everything and dispose of all produced water" was the completion method of choice. Our plan for an upper Wolfcamp interval is shown below. The completion and production results are displayed in *Figure 5*.
The practice of perforating and fracturing every zone is slowly being replaced with more intelligent completion designs.

Conclusion

The science of improving well production and extending the life spans of producing wells with fracturing technology is becoming more accepted and popular. Largely driven by unconventional reservoirs in North America, it is rapidly becoming a worldwide practice. The use of petrophysical interpretations to generate inputs to fracture simulation models is a crucial component to generating solid fracture designs and completions and maximizing a well's potential.

FIGURES

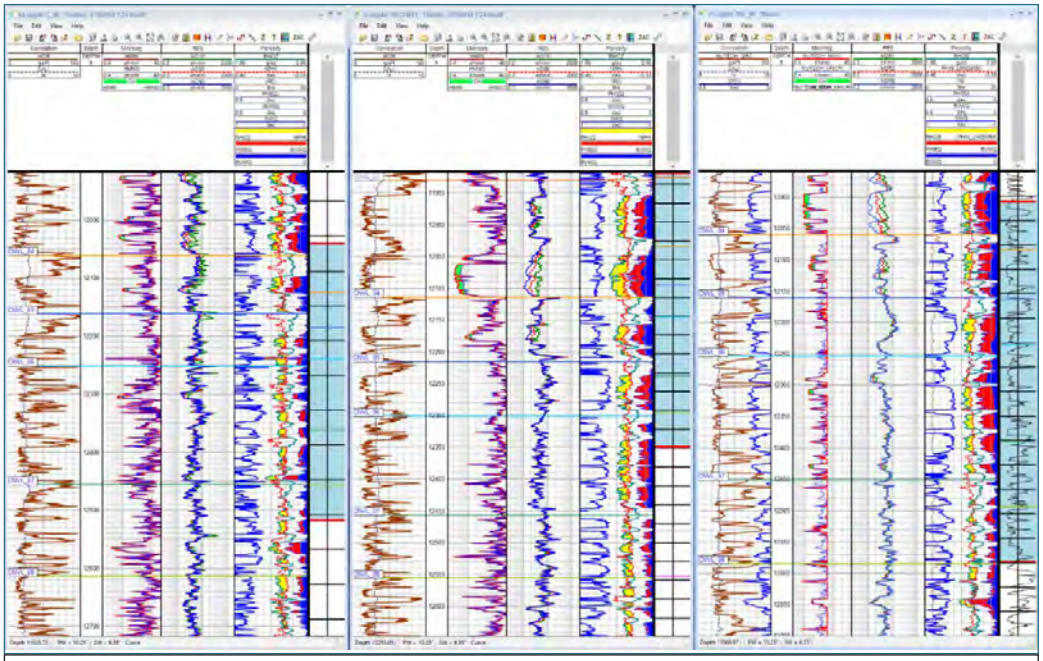


Figure 1: Type log Mississippi tight gas sand.

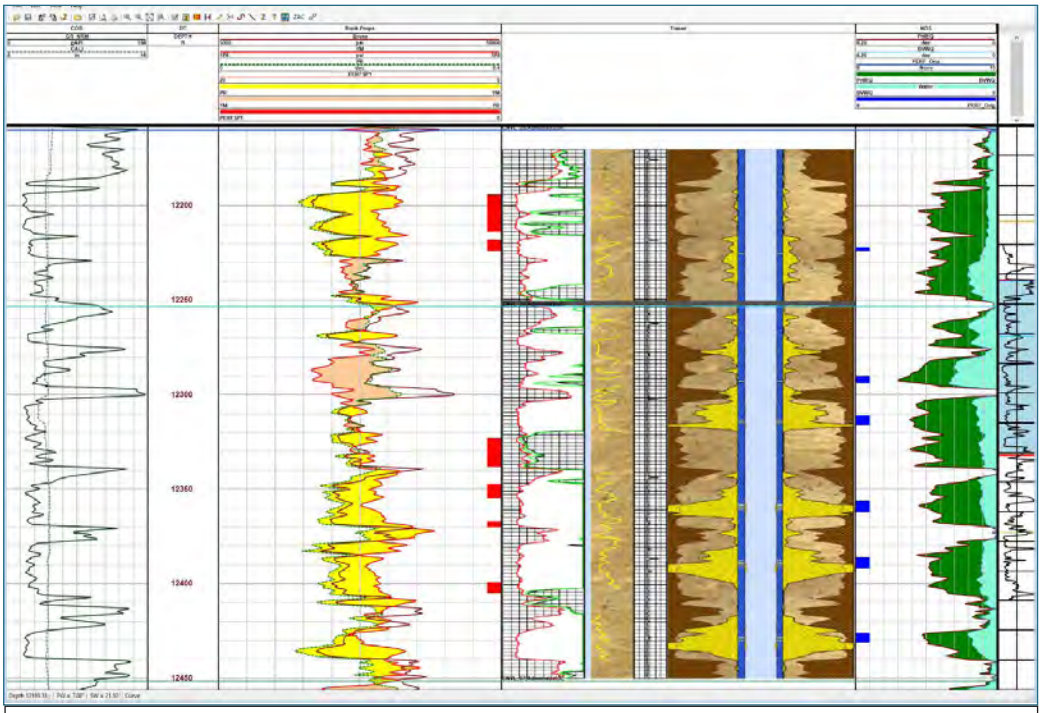


Figure 2: Elastic properties derived from logs in Figure 1.

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Fracture Simulation Parameters... continued

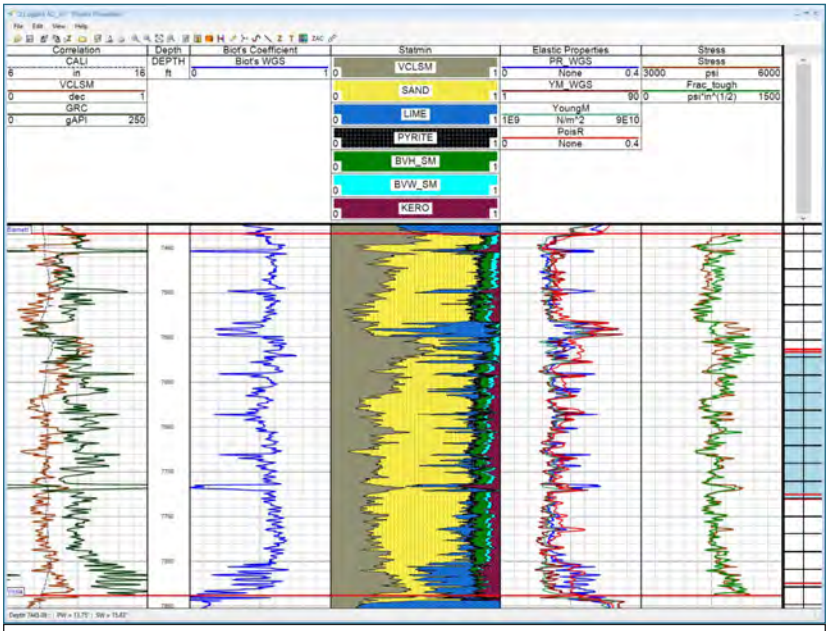

Figure 3: Type log from Spraberry Wolfcamp shale play.

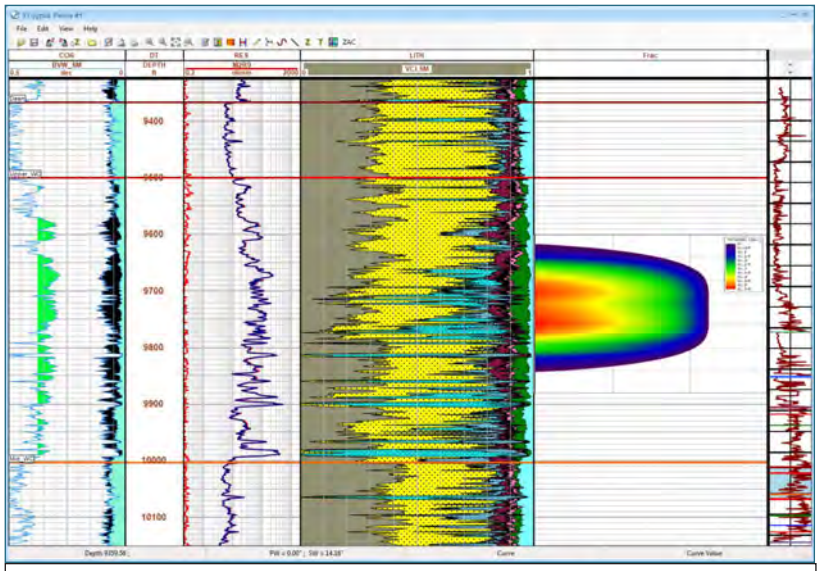

Figure 4: Elastic properties and planned frac design for Wolfcamp well.

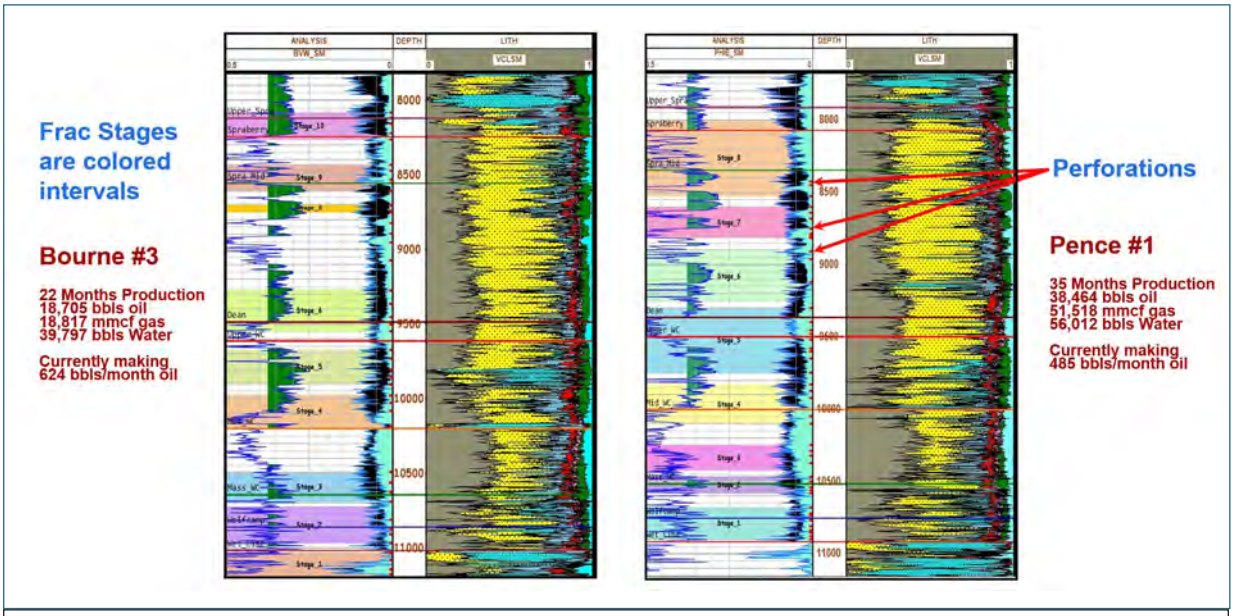

Figure 5: Production Results from fracture stimulations in two Wolfcamp wells.

WHAT HAS SPE LONDON DONE FOR ME?

The SPE is a global organisation of 88,000+ E&P industry professionals.

The SPE London board oversees the SPE London activities including our evening programme and other events. Our various committees have specific focus for the members including Young Professionals, Women in Energy and associated student chapters. As well as engineers who make up our core, we also welcome those with qualifications in geology, geophysics, earth science, environment, health and safety, mathematics, information technology, as well as management and economics.

Piers Johnson, OPC

> The SPE has been good, not only for me personally in a technical capacity, but also for my company Oilfield Production Consultants (OPC) Ltd, in helping develop business from the SPE community. The membership of the SPE is diverse both technically and geographically, and I have had the pleasure of being invited to make technical presentations internationally as well as locally in the London and Aberdeen. An SPE event, of any size or nature, is always an excellent place to meet like-minded fellow professionals both technically and socially.

> The SPE has given me multiple opportunities. Early in my career I was given responsibility and gained experience in being a member of and also chairing the SPE London Section committee. It helped expand my professional network through finding speakers and attendees for the continuing education seminars and attending meetings. To plan successful seminars, I kept abreast of technology and topics that were relevant to the London audience, improved my marketing skills (mainly powers of persuasion) and made a healthy profit for the section. After many years in the London section committee, I became a non-executive director for SPE Europe, another great learning experience. As the SPE is a global organisation, I have met and made friends with members all over the world and have helped set up a new SPE section in Namibia. I'm also very proud of helping to promote the 'Women in Energy' seminars in their early years.

Clara Altobell (former Chair)

Richa

> Being part of SPE London has provided me great opportunity to connect with like-minded people in Energy sector. Volunteering with the section has broadened my skills - it provided me an opportunity to work on my Leadership skills while getting connected with other volunteers. Attending various meetings by the section, I not only learned about technical and non-technical topics pertaining to the industry but also met energy professionals from all across the energy sectors.

Can the UK become a world leader in CCUS?

Nikki Brain
Policy Mgr., CCSA

Nikki Brain, Policy Manager, Carbon Capture and Storage Association, provides an overview of her talk at the London Section evening meeting on 29 May, 2018.

Introduction

In 2017, the UK Government set out its Clean Growth Strategy[1], which aimed to demonstrate how the UK can meet its fourth and fifth carbon budgets while maximising value to the UK economy. Globally and in the UK, "clean growth" industries are growing rapidly, driven by the global ambition to tackle climate change and to provide cleaner and more efficient technology solutions. Carbon Capture, Utilisation and Storage (CCUS) is not a single technology but comprises three main technologies: capture, transport and storage for potential reuse or for permanent storage in geological formations such as depleted oil and gas fields, or saline aquifers (see Figure 1 and [2]).

There is significant evidence to suggest that without large-scale deployment of CCUS the cost of meeting the UK's 2050 climate change targets will be 50% higher. Furthermore it is estimated that timely development of CCUS could add upward of £164bn in value to the UK economy to 2060, outweighing the cost of development by a ratio of 5:1.

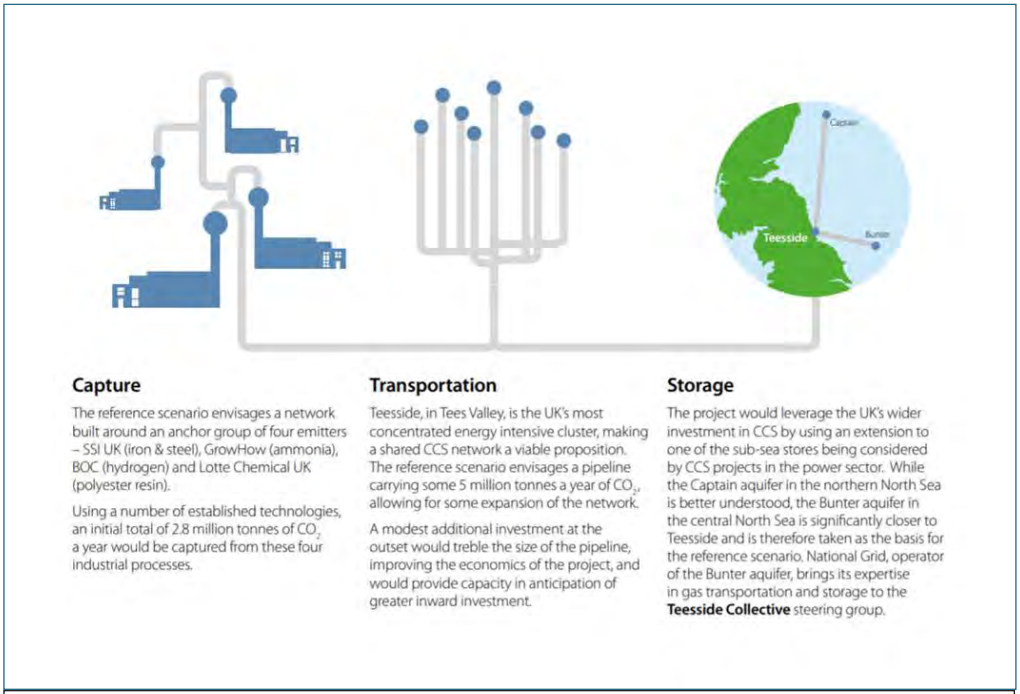

Figure 1: The three main CCUS technologies: capture, transport and storage.

CCUS can enable cost-effective decarbonisation across heat and transport (through production of hydrogen) and power. Furthermore, CCUS provides the only solution for decarbonisation in industries such as steel, cement and chemicals which produce CO2 as part of the manufacturing process, enabling these vital industries to remain competitive in a low-carbon economy. In light of this, the Clean Growth Strategy set out the government's ambition to deploy CCUS at scale in the 2030s; and to become a "global technology leader" in this space.

The development of CCUS is also integral to the future of the petroleum industry. It is estimated that without CCUS, the UK must use only 10% of the amount of gas we used in 2010 by 2050 if it is to meet carbon budgets. If CCUS is available at scale, we may still use 50% of the amount of gas we use today, including using natural gas with CCUS to create low-carbon hydrogen for heating.

The UK government has highlighted decarbonisation of heat as "our most difficult policy and technology challenge to meet our carbon targets". In light of this the Department of Business, Energy and Industrial Strategy (BEIS) is currently undertaking a review of decarbonisation options including electrification and conversion of the gas grid to hydrogen [3]. CCUS can unlock production of low carbon hydrogen through capturing CO2 from the Steam Methane Reforming (SMR) process, and is considered the best method for producing large volumes of low-cost clean hydrogen. A recent study demonstrated that repurposing the newly upgraded gas networks for use with hydrogen could reduce the cost of heat decarbonisation by £300m compared to relying on electrification alone.

UK-based projects are emerging which aim to develop a regional hydrogen economy. The Leeds H21 study led by Northern

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Can the UK become a world leader in CCUS? continued

Gas Networks sets out what 100% conversion of the gas grid in Leeds to hydrogen could look like, using SMRs linked to CO2 storage in the North East. The HyNet project developed by Cadent Gas in the Liverpool-Manchester area aims to produce decarbonised hydrogen for industrial use, with the excess being blended into the gas network. Partial blending avoids the need for switching appliances in homes and could create an early market for hydrogen.

The UK has some significant advantages which make it well placed to become a leader in CCUS. Firstly, just 15% of the UK's potential CO2 storage capacity would be sufficient to store 100 years worth of current UK emissions- much more than we would ever require. This means we could also offer a service to store CO2 from other countries. Secondly, we have a world-class oil and gas sector which is in decline; stimulating a CCUS industry could secure jobs for the future and create new ones. Thirdly, we have an excellent research base in CCUS, including specialist R&D facilities.

Despite the necessity of CCUS, development has been slow. Twenty-one CCS projects are operational at a commercial scale globally; these encompass power stations, industrial capture, and hydrogen production. For the most part these have been driven by the utilisation of CO2 for Enhanced Oil Recovery (EOR); in the case of Norway, its two existing projects on oil refineries were driven by the implementation of an offshore tax on CO2 emissions. The global picture demonstrates that while the technology is available, the commercial drivers to bring CCUS forward at scale do not yet exist.

As part of the Clean Growth Strategy, the UK Government set up a Cost Challenge Task Force, which brings together industry, academia and other stakeholders to set out to government how cost reductions can be achieved to enable CCUS to be deployed "at scale" in the 2030s. The first thing to note when addressing this question is that the biggest driver of cost reduction will be commercial deployment. The offshore wind sector is a clear demonstration of this; allocated a target by government of 18GW deployed by 2020, alongside a support mechanism through the Renewable Obligation and then Contracts for Difference, the sector delivered ahead of time and with significant cost reduction.

By introducing a clear target for CCUS deployment and a trajectory of how to get there, along with a mechanism that enables a return on investment, government can provide the certainty needed for the private sector to begin to develop CCUS projects. As with offshore wind, the first smaller projects may have a higher unit cost than subsequent projects, but they will provide the critical first steps that will drive the cost reduction to enable scale-up.

Another key factor to reducing the cost of CCUS in the UK is the development of shared CO2 transport and storage infrastructure, enabling the cost of the infrastructure to be socialised over a number of capture projects. During the UK's commercialisation competition, which was cancelled in 2015, projects were aiming to develop oversized infrastructure to enable other CO2 sources to be added over time; however, the full costs of developing this infrastructure were passed on to the capture projects making the cost per unit of electricity look unnecessarily high. By developing transport and storage separately to CO2 capture, the cost of CO2 storage could be fairly distributed between capture projects. This could effectively be managed by a regulated entity in the way gas and electricity networks are managed today.

Infrastructure should first be developed in regions with multiple emitters located close together and near to offshore storage sites. This will lead to the creation of CCUS "clusters"; examples include Teesside, Grangemouth, South Wales, Liverpool-Manchester, and the Humber. This will enable economies of scale to be achieved, as well as effective coordination of the multiple actors across the chain.

Finally, development of a market will incentivise further technological innovation to take place across the CCUS chain, leading to more efficient methods of capture, utilisation and storage over time.

The UK has significant potential to drive development and deployment of CCUS, to enable cost-effective decarbonisation while delivering significant value to the economy. By the end of 2018 we hope to see government set out a clear path forward for the industry in the UK, and the steps government and the private sector will take to meet the ambition of becoming a leader in this space.

References

[1] Clean Growth Strategy, UK Government Paper, https://www.gov.uk/government/publications/clean-growth-strategy

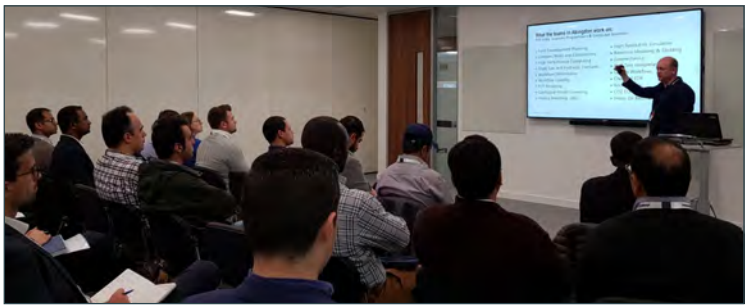
[2] Teesside Collective, http://www.teessidecollective.co.uk/

[3] https://www.telegraph.co.uk/business/2018/01/06/hydrogen/

Reservoir Simulation day for SPE London's Young Professionals

A successful event was organized by SPE YP London technical team to spread knowledge among young professionals and students. A visit to Abingdon Technology Centre (AbTC), the Schlumberger Centre of Excellence for Reservoir Engineering, was organized in April to provide learning opportunities and extend collaboration with the industry.

Thirty SPE young professionals and students were invited to visit the Schlumberger Abingdon Technology Centre to gain an insight into the advancements in the reservoir simulation and how Schlumberger keeps up with the emerging technologies. The group was welcomed by Marie Ann Giddins (Reservoir Engineering Advisor), Abrar Pewekar (SPE YP Chair) and Samita Santoshini (Senior Reservoir Engineer, Schlumberger), who accompanied the group throughout the visit.



David Rowan (Technology Centre Manager) introduced and welcomed everyone to AbTC. This was followed by an interesting talk by Juan Jose Quijano Velasco (Technology & Solutions Manager-Reservoir Engineering) who highlighted current technical challenges in the oil and gas industry and described how Schlumberger provides state-of-the-art products and solutions today, and invests in emerging technologies such as big data analytics and internet of things, promising exciting years to come.

The morning continued with updates on recent developments by the software engineering teams with the highlight being a new field development planning application on Schlumberger's cloud platform, DELFI, presented by Kwangwon Park (Product Analyst – Asset Modelling).

After an interactive lunch break, the next series of presentations was started by Marie Ann Giddins (Reservoir Engineering Advisor), who highlighted the variety of consulting cases studies done by reservoir engineering experts in Abingdon Technology Centre. This was followed by some deep-dive technical presentations and case studies on Enhanced Oil Recovery by Jean Gossuin (Product Champion – ECLIPSE), Waterflood Optimization with Streamlines by Daniel Dias (Senior Reservoir Engineer), Complex Reservoir Modelling by Samita Santoshini (Senior Reservoir Engineer) and Integrated Asset Modelling by Pierre Amoudruz (Senior Petroleum Engineer).

The event concluded with a hands-on workshop on PETREL RE software. Group of four were given a task of improving the recovery factor from a sector model with faults and four wells. Teams could change the location of the wells to target the un-swept area, well type (Producers/injectors) and injection rates. The technical experts were available throughout the day, to share their experience and answer queries from all the participants, and we saw happy faces leaving the Schlumberger premises at the end of the day.

The SPE YP London Committee thanked Schlumberger's staff for organising such a dynamic and informative event and is hoping to visit the centre again next year.

Meet the SPE London Board

SPE is a non-profit professional society with 164,000 members in 143 countries. SPE London Section, with average 2000 members and seven associated student chapters, is an active section with an aim to connect, engage and promote exchange of knowledge within London energy community of technical and commercial professionals. The SPE London Board is the policy-making and governing body consisting of volunteers who devote their time to oversee many of SPE London's administrative and operating responsibilities.

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Chair

Richa

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Cleone Butler
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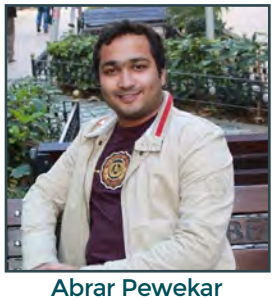
Isabel Asenjo
Women in Energy Chair

Kanad Kulkarni,
Student Chapters Liaison



Abrar Pewekar
Young Professional Chair

Jonathan Ovens
Director, Editor SPE Review

Anthony Perry
Director

Arnaud Mille
Long Term Planning

Alain Gringarten
Director

EVENTS: Upcoming global events 2018

27-29 August 2018 **(Bangkok, Thailand)**
IADC/SPE Asia Pacific Drilling Technology Conference and Exhibition
Reshaping for a Smart and Sustainable Future
Since 1996, the IADC/SPE Asia Pacific Drilling Technology Conference and Exhibition has established itself as the region's leading drilling event. Rotating biennially within Asia Pacific, it provides the opportunity for operators, suppliers, contractors, and service company professionals to meet, discuss, evaluate, and share ideas to advance drilling operations, promote solutions to common problems, and improve overall efficiency and profitability.
For more information, and to register: https://bit.ly/2MHcBFK

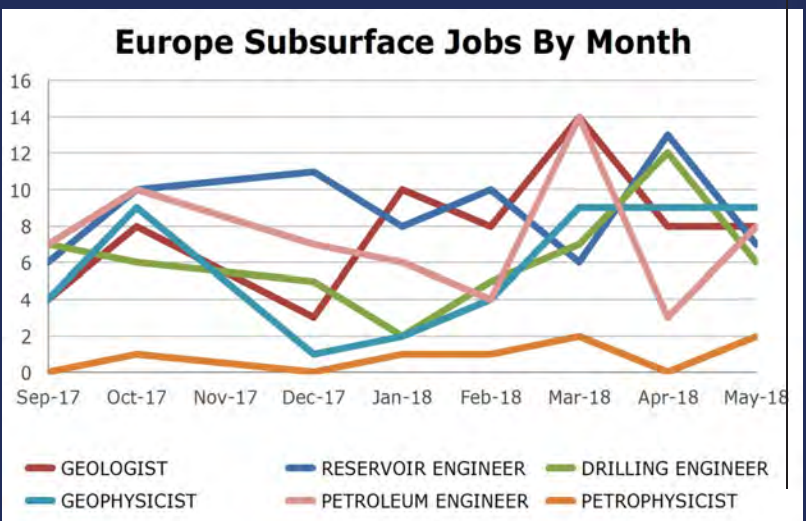
28-30 August 2018 **(The Woodlands, Texas)**
SPE Artificial Lift Conference and Exhibition - Americas
The SPE Artificial Lift Conference and Exhibition-Americas will bring together E&P innovators from major IOCs, NOCs, and independent operators to exchange ideas to advance technical knowledge in artificial lift applications for unconventional shale developments.
For more information, and to register: https://bit.ly/2llLsvK

4-6 September 2018 **(Aberdeen, Scotland)**
Engenious Symposium & Exhibition For Upstream Innovation
A new event, for your digital era...
We are ENGenious. Our goal is to drive radical transformation across the upstream oil and gas industry. Join us at the first ever global event focused specifically on what innovation means for the onshore and offshore upstream oil and gas industry. Help your company thrive with new technological advances aimed at keeping you ahead.
For more information, and to register: https://bit.ly/2AeWVDR

18-19 September 2018 **(London, England)**
SPE Workshop: Petroleum Reserves and Resources Estimation
Members of the SPE Oil and Gas Reserves Committee and industry experts will gather in an open forum to discuss the revised classification, definitions and guidelines included in the 2018 SPE/WPC/AAPG/SPEE/SEG/SPWLA/EAGE Petroleum Resource Management System, recently submitted for SPE board approval.
For more information, and to register: https://bit.ly/2lotmcB

23 October 2018 **(London, England)**
SPE London Conference
The program is designed for a mix of technical, commercial, and financial professionals and investors to address key topical issues that each stakeholder faces while making business, investment, and policy decisions.
For more information, and to register: https://bit.ly/2lFLdvP

PETROLEUM SUBSURFACE JOBS - EUROPE



Selected Live Jobs at Print

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Oslo, Norway

Senior Reservoir Engineer
London, UK

Completions Engineer
Aberdeen, UK

Senior Geologist & Geophysicist
Oslo, Norway

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