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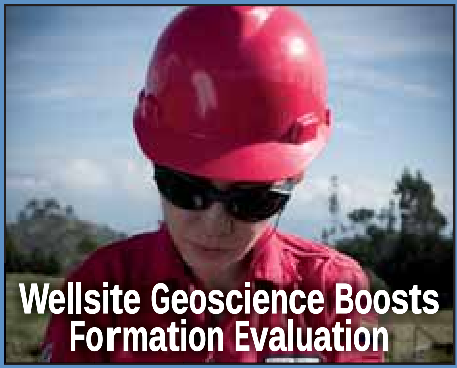

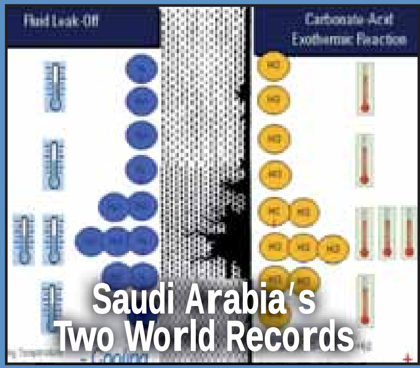

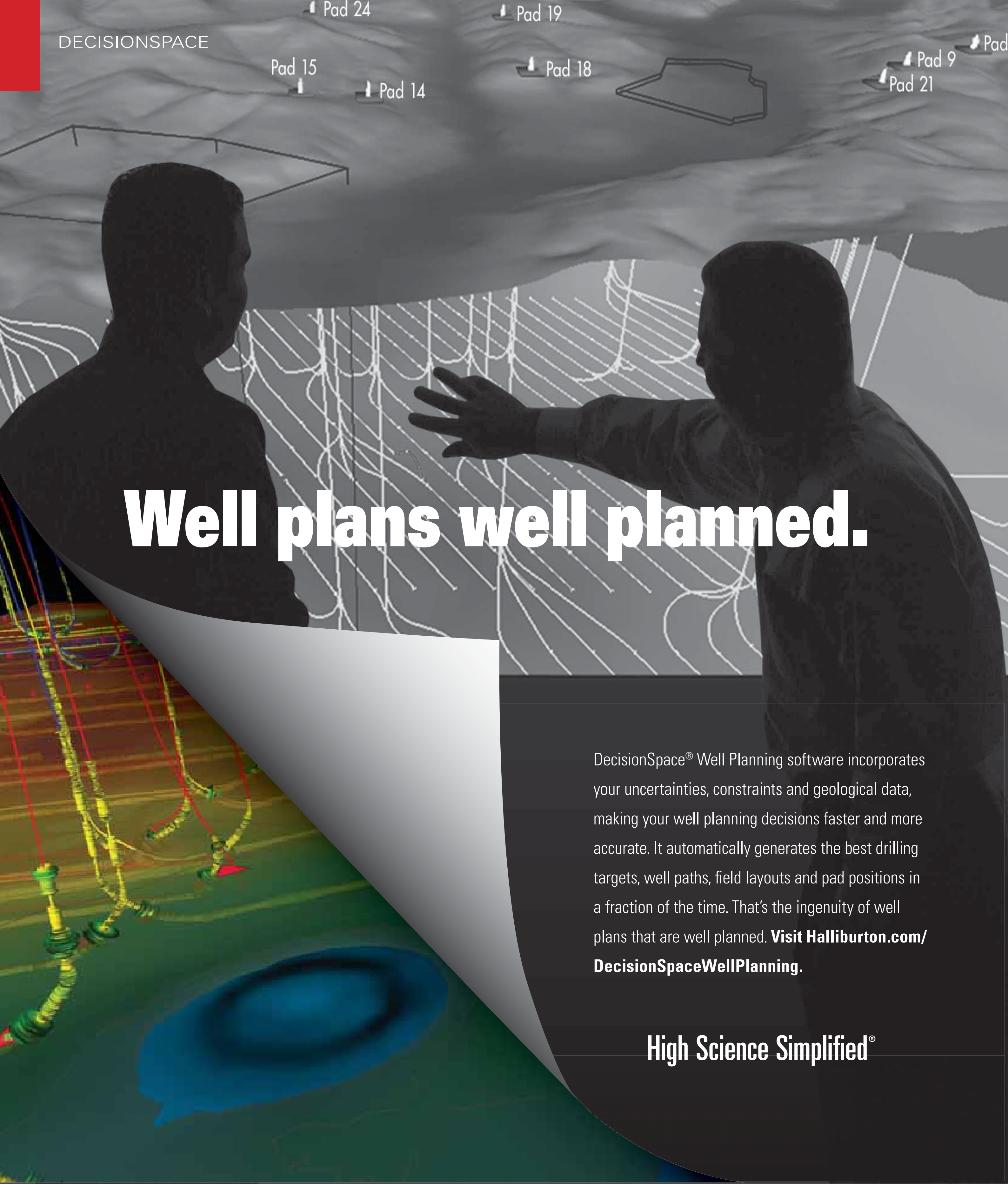
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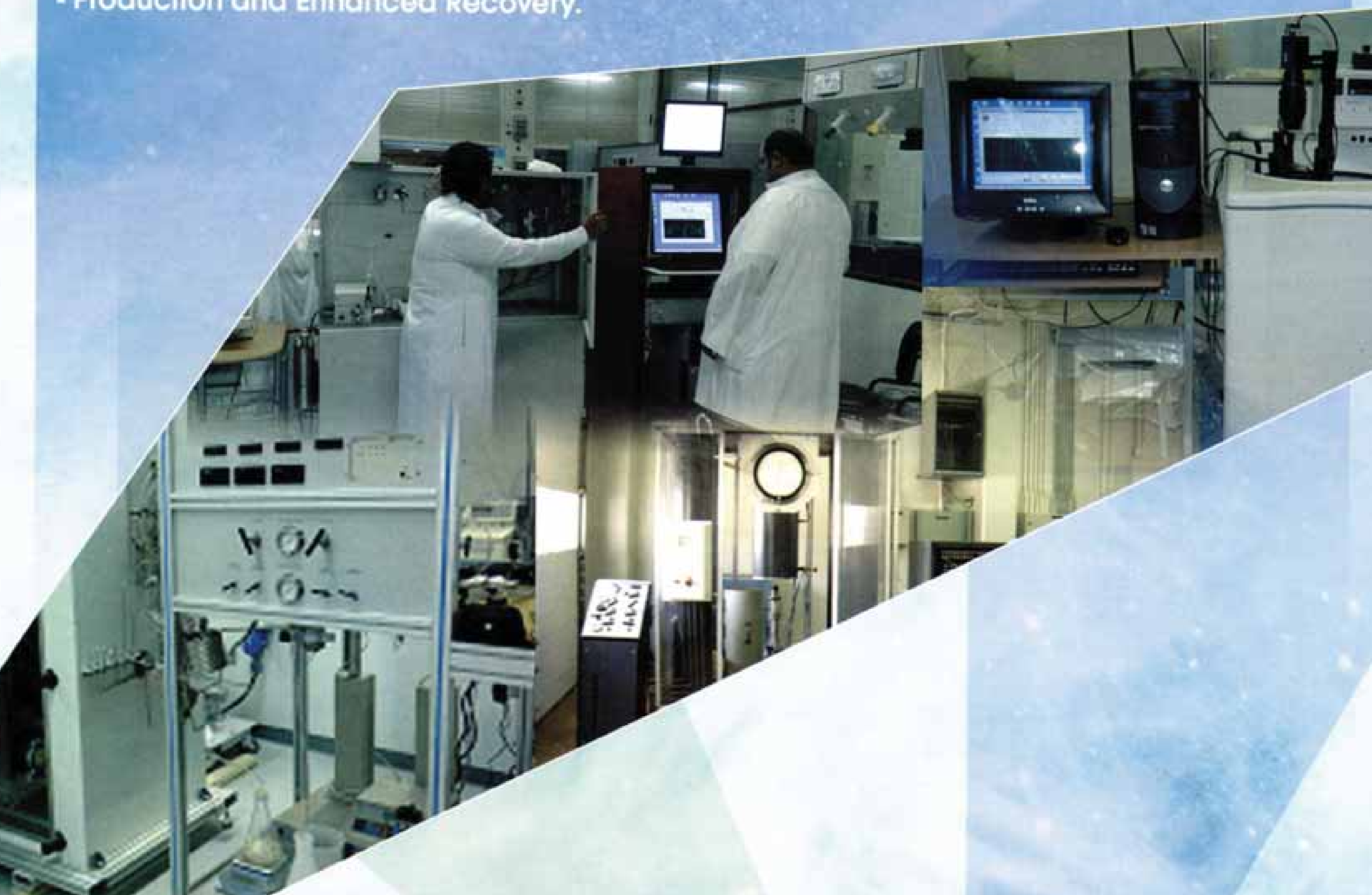
Oil and Gas Research Institute

Hydrocarbon resources (crude oil and gas) are the main source of world energy, and as the international demand increases, the technical challenges increase to meet that demand. Hydrocarbon production optimization at minimum cost and the need to serve the national petroleum industry has been the driving force behind the establishment of the Oil and Gas Research Institute (OGRI) at King Abdulaziz City for Science and Technology (KACST). OGRI is a governmental research and development entity. Its applied research activities concentrate on the upstream sector of the petroleum industry. Fields of interest cover most of the petroleum science and engineering aspects through four main divisions:

- Reservoir Characterization and Numerical Simulation,
- Drilling Engineering,
- Rock Mechanics,
- Production and Enhanced Recovery.



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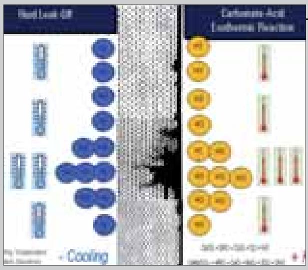

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Workshops Capitalize on Talent in Jazan

JAZAN, Saudi Arabia, 30 January 2013

A targeted recruitment program for Saudi nationals to develop local employment for Saudi Aramco's next mega-project is already making large strides.

Jazan Refinery and Terminal Project (JRTP) recently inked contracts between Saudi Aramco and seven contractors, who will start construction on the refinery next year.

In tandem, an energetic recruitment program overseen by Saudi Aramco Project Management (SAPM) has ignited sizeable interest among locals for the job opportunities offered by JRTP.

When completed in late 2016, JRTP will process 400,000 bpd of Arabian Heavy and Arabian Medium crude oil. It will also produce 80,000 of gasoline, 250,000 of ultra-low sulfur diesel and over 1 million tons per year of benzene and paraxylene products.

A series of workshops are being held both in-Kingdom and out-of-Kingdom and are set to continue throughout 2013. Jazan was one of the recruitment areas explored for the first time.

The recruitment program will be coordinated across the world and will involve more than 10 contractors working across different time zones.

In keeping with the vision of King Abdullah, who launched the Jazan Economic City Project as part of a strategy to revitalize the region's economic activity and serve domestic energy demands, there are ambitious Saudization targets for each of the project's contract packages.

At the peak phase of the refinery construction, the Saudi workforce could exceed 4,000 employees hired by the construction contractors.

Those working on the project say that the Jazan project team will continue the tradition of Saudi Aramco delivering world-class mega-projects, not only safely and on time but with a significant contribution from local talent.

Forum Addresses Energy Efficiency

DHAHRAN, 30 January 2013 – “Achieving energy efficiency is a strategic goal for Saudi Aramco as well as everyone in the oil and gas industries as it reduces the pressure on the already strained resources on a global scale,” said Mohammed A. Al-Omair, vice president of Pipeline Distribution and Terminals.

In partnership between the Energy Management Steering Committee and Terminal Operations Department, the 2013 Energy Conservation Forum took place Jan. 15 and 16 under the theme “Achieving Best-in-Class Energy Efficiency Level.”

In his opening remarks, Al-Omair indicated that the rise in energy prices is causing consumers to pay greater attention to energy efficiency, which is highly desirable. It is also attracting higher levels of investment in new and alternative energy sources.

In parallel, the impact of deregulation - in particular in the field of power generation – is expected to lead to a more efficient use of hydrocarbon fuels and, eventually, to lower the level of energy intensity.

Al-Omair noted that in past years, the national demand on energy has increased drastically to the point where the portion meant for export may decline to very low levels in the coming two decades. For example, the national demand for electricity has increased by about 7 to 8 percent annually for the past five years. Therefore, being efficient in energy utilization is a national goal and concern, and it is the responsibility of everyone.

He added that Saudi Aramco has been well aware of the importance of energy efficiency through cost-effective and efficient resource management practices. Therefore, the company launched energy conservation policies to improve levels of energy efficiency in all operating facilities, whether they are industrial or nonindustrial, to support energy efficiency efforts in the Kingdom.

Ahmed O. Al-Khowaiter, chief engineer and chairman of the Energy Management Steering Committee, gave the keynote address emphasizing the importance of leading, implementing and achieving best-in-class energy efficiency levels for Saudi Aramco’s operations and the Kingdom.

> “... the company launched energy conservation policies to improve levels of energy efficiency in all operating facilities, whether they are industrial or nonindustrial, to support energy efficiency efforts in the Kingdom.”

“We need to identify actionable programs that can be applied to reduce energy consumption in our everyday life practices in and around the company. We must export these concepts in collaboration with the National Energy Efficiency Initiative focusing on three areas: industry, production and transportation,” he said.

The forum’s topics were divided into four basic sessions with presentations selected to reflect Saudi Aramco energy conservation activities and lessons learned from various plants and departments. Presenters also included local and five major international energy companies.

Fundamental research and development in the field of renewables was included through the participation of King Fahd University of Petroleum and Minerals. Major national companies were represented by SABIC, with a presentation highlighting its energy conservation program and initiatives.

Center for World Culture Holds "Creativity Forum 2013"

DHAHRAN, 30 January 2013 – The King Abdulaziz Center for World Culture held its first annual Creativity Forum in Dhahran with a series of presentations, panel discussions and interactive workshops featuring artists, scientists, architects, engineers, entrepreneurs and designers.

The two-day program focused on creativity and innovation with the theme of "Bridging the Gap between Conceptualization and Realization," and drew more than 600 professionals, educators, students and members of the local community.

Further public participation was encouraged through the Cultural Center's highly active Twitter account and the social media platforms of its followers. Participants found the event vibrant, full of youthful energy and inspiring.

The gathering opened with remarks by Abdulaziz F. Al-Khayyal, Saudi Aramco senior vice president for Industrial Relations, who said, "I believe this interdisciplinary gathering focused on creativity is unprecedented in the Kingdom, and reflects both the Center's ambitions as a pacesetter institution and its commitment to explore and enhance the methodology of innovation."

He went on to say that "as we strive to grow vibrant industrial, manufacturing and services sectors, improve our educational system, and put in place the conditions necessary for a knowledge-based economy to thrive in the Kingdom, we need creativity and innovation."

Speaking of the King Abdulaziz Center, a major cultural and educational facility being developed in Dhahran by Saudi Aramco, Al-Khayyal said, "Part of our mission is to provide a forum for the exchange of ideas and to be an incubator for inspiration and innovation – which is what is happening today and tomorrow with the Creativity Forum. The Center is also championing the interdisciplinary, art-science approach to innovation. In short, we want to support and celebrate the creative talents and innovative professionals we have among us, and enable them to translate their fresh ideas and new ways of seeing the world into tangible results."

Al-Khayyal concluded by saying, "We need to have an authentic Saudi voice in the great global discussions of our time, and to ensure that our country and our citizens are creators of unique ideas, meaningful cultural expressions, innovative companies, and forward-looking technologies and solutions."

The first day's speakers and panelists included contemporary Saudi artist Manal AlDowayan, Saudi industrial designer Ahmed Angawi; Joe Davis, Artist in Residence at the Massachusetts Institute of Technology and Harvard University; the Canadian visual artist

> We need to have an authentic Saudi voice in the great global discussions of our time, and to ensure that our country and our citizens are creators of unique ideas, meaningful cultural expressions, innovative companies, and forward-looking technologies and solutions.

Karim Jabbari; Nabeel Koshak of Umm Al-Qura University; and the Dutch virtual artist Sander Veenhof, as well as two panel discussions dedicated to "Building a Creative Economy" and "Crossing the Line Between Art and Science."

The session concluded with two hands-on, interactive workshops that investigated the links between architecture and design and explored the use of light to create nighttime displays of Arabic calligraphy; workshop facilitators were Saudi architect Ahmad Baageel, Saudi interior designer Sara Al Humaidhi, and Karim Jabbari.

The Creativity Forum's second day was opened by Mohammed Y. Al-Qahtani, vice president for Saudi Aramco Affairs, and featured a series of presentations and panels related to architecture, engineering and sustainability with special reference to the iconic King Abdulaziz Center facility, which is now under construction.

Among the speakers were architect and scenologist Professor Uwe Bruckner; Roberto Fabbri of Buro Happold, which is developing the Center facility's innovative steel pipe façade or "skin"; Jenny Osuldsen of Snøhetta, the architects of the King Abdulaziz Center; science communicator Tom Pringle; rammed earth construction specialist Martin Rauch; and construction engineer Thomas Spitzer.

The day's panel discussions highlighted the challenge of making the King Abdulaziz Center more than an architectural landmark, as well as "Pushing the Boundaries of Industry."

The Creativity Forum will be an annual event, and will continue to explore issues related to creativity, innovation, cultural expression, architecture and design, as well as the positive impact of the creative industries on society and the economy.

The public captured the event with various favorable tweets. One tweet from a local engineer stated: "the creativity forum showed me that the King Abdulaziz Center for World Culture is not just a monumental building. It will also be a source of enrichment for the region in all things creative and innovative."

Workshop Focuses on Intelligent Fields

JU'AYMAH, Saudi Arabia, 30 January 2013

The first Northern Area Oil Operations (NAOO) Intelligent Field knowledge sharing and technology workshop was held recently.

The event was held in collaboration with the Society of Petroleum Engineers' (SPE) Saudi Arabia Section and was sponsored by the Northern Area Production Engineering and Well Services Department (NAPE&WSD). More than 80 industry leaders and professionals from Saudi Aramco and service providers used the workshop to exchange experiences and best practices associated with the adoption of smart oil field technologies.

According to NAPE&WSD manager, Naji Umair, "The workshop is part of NAOO's continuous efforts to unlock the full potential of Intelligent Field technology and maximize its benefits." He added that "the potential impact of Intelligent Field technology on improving safety and cost efficiency is substantial, especially in offshore and remote fields where accessibility and geographic remoteness is challenging in conventional data acquisition operations."

The deployment of Intelligent Field technology is part of a long-term strategy to collect and use real-time wells and surface equipment data to make timely optimized production and reservoir management decisions. Intelligent Field technology is becoming essential for ensuring enhanced oil and gas recovery and reducing operating costs, especially with the current expansion of Saudi Aramco exploration and development activities.

The workshop paved the way to further enhance operational excellence through informative demonstrations of innovative intelligent field workflows, instrumentation and applications.your kind attention."

Stanford Club of Saudi Arabia Launched

RIYADH, 30 January 2013 – Led by two Saudi Aramco employees, Dr. Ibrahim Al-Mojel from Corporate Planning and Saad Al-Gheriri from Treasury, The Stanford Club of Saudi Arabia conducted its inaugural event on 6 January at a Riyadh hotel.

Guests of honor included HE Dr. Fahad Balghunaim, Minister of Agriculture of Saudi Arabia, and Dr. John Etchemendy, Provost of Stanford University. More than 70 alumni from multiple regions in Saudi Arabia attended the event, and with the collaboration from the university, the club was able to reach out to more than 150 alums in the Kingdom.

The club was formed to achieve three main objectives:

1. To provide members of the club with opportunities for personal and professional development through hosting intellectual events and other developmental activities.

2. To foster and strengthen relationships and interaction among Stanford alumni.

3. To reinforce the link between alumni and Stanford University and promote collaboration between Saudi institutions and Stanford.

The program started with Saad Al-Gheriri, vice president of Stanford Club of Saudi Arabia, welcoming and thanking the attendees for their support, giving an overview of the program, and introducing the guests of honor. Then, Dr. Ibrahim Al-Mojel, club president, reviewed the club's structure, initiatives and the plan going forward.

Afterward, Etchemendy talked about Stanford's strong ties to Saudi Arabia since the early days of oil exploration when oil was first discovered by Max Steineke, who was a graduate of Stanford University.

Al-Naimi Delivers Keynote at Offshore ME Conference

DOHA, Qatar, 6 February 2013 – Nasir K. Al-Naimi, vice president of Northern Area Oil Operations, recently took a crowd of Offshore Middle East Conference and Exhibition participants on a historical journey through Saudi Aramco's investment in offshore operations.

The conference and exhibition was held January 21-23 at the Qatar National Convention Center in Doha, with HE Dr. Mohammed bin Saleh Al-Sada, Minister for Energy and Industry of Qatar, opening the conference.

This year's event featured more than 60 speakers from nearly 20 countries and hosted more than 40 exhibitors. Topics covered included well construction and drilling, gas operations, field development, asset integrity, human resources/training and reservoir management. The three-day event also included sessions relevant to all aspects of natural gas and gas liquids – in parallel with the upstream and exploration emphasis – that have not been observed at previous Offshore Middle East events.

Al-Naimi spoke of how Saudi Aramco's investment in offshore operations started with the development of the Safaniya field and led to recent accomplishments in producing Saudi Aramco's first offshore nonassociated high-pressure, high-temperature gas from the Karan field and the ongoing investments in Manifa, Arabiya and Hasbah fields.

Al-Naimi also talked about two major gas projects in the Karan and Wasit fields, noting that these projects feature state-of-the-art gas development technologies with unique large bore well designs, automated control systems and intelligent field infrastructure that maximize well productivity with the highest levels of safety.

Al-Naimi went on to explain how Manifa's development exemplifies the powerful combination of technology and innovation in a shallow marine environment. Plans are for the Manifa field to produce 900,000 barrels per day of Arab Heavy crude oil in the most cost-effective, safe and environmentally responsible manner.

In addition to the delivery of a keynote address at the Operators' Perspective session, Saudi Aramco sponsored the event, and Northern Area Production Engineering and Well Services Department (NAPE&WSD) presented a paper titled "Systematic Approach to Integrate a Comprehensive Surface and Subsurface Well Integrity Management System".

Saudi Aramco, IFPen Team Up for Research

PARIS, France, 6 February 2013 – Saudi Aramco has signed a long-term collaborative agreement with IFP Energies Nouvelles (IFPen) to conduct research activities designed to position oil-based fuels as competitive enablers for future transportation.

The collaboration agreement with IFP Energies Nouvelles (IFPen) marks the establishment of the company's first out-of-Kingdom downstream satellite research center. In 2012, Saudi Aramco established its first satellite R&D center center at King Abdullah University of Science and Technology in Thuwal on the Kingdom's West Coast.

The signing ceremony took place at IFPen headquarters in Paris and was attended by: Nabil Aldabal, Aramco Overseas Co. managing director, who signed the agreement; Ashraf Al-Ghazzawi, Saudi Aramco R&DC acting manager; and IFPen executive vice presidents Pascal Barthélemy and Georges Picard.

The agreement will allow Saudi Aramco to capitalize on IFPen's established innovation position, world-class facilities, experienced scientists and industrial links to various European automakers. In turn, this will accelerate the innovation cycle of the various fuel technologies pursued by Saudi Aramco. The collaboration will also facilitate closer interactions with various European stakeholders and will serve as a platform for technology and competency transfer to the core team in Dhahran.

Under the framework of this agreement, Saudi Aramco's R&DC will jointly conduct research projects that draw manpower from both parties while utilizing IFPen's facilities and equipment. The projects will focus on developing new petroleum fuel solutions for advanced and emerging types of transportation combustion engines. Such solutions are designed to maintain the competitiveness of Saudi Aramco's petroleum fuel products in terms of efficiency, environmental impact and affordability.

The satellite center is planned for inauguration toward the end of February.

Saudi Arabia's Two World Records for Aided Coiled Tubing Reach and Real Time Logging in Extended Reach Well

By James O. Arukhe, Mubarak A. Dhufairi, Saleh A. Ghamdi, Laurie Duthie and Karam Yateem, Saudi Aramco; Tamer Elsherif and Danish Ahmed, Schlumberger.

This paper was prepared for presentation at the Abu Dhabi International Petroleum Exhibition & Conference held in Abu Dhabi, UAE, 11–14 November 2012.

Abstract

Two new records exist in one of the world's largest oil increment field development projects in Saudi Arabia. The records set while achieving a well's intervention objectives include: (1) Attaining the deepest coiled tubing (CT) reach for rigless well intervention at 29,897 ft (9.11 km) measured depth in an extended reach open hole horizontal power injector well using a CT tractor, and (2) The first application of real time logging enabled through a wired motor head assembly via the tractor. The intervention objectives were to acid stimulate an open hole completed relatively deep in the reservoir with total depth (TD) of 29,897 ft and open hole length of 6,697 ft utilizing 2" CT with open hole tractor, to perform injectivity/falloff test, and to conduct real time logging for evaluating the reservoir's injectivity profile.

The paper examines several challenges that engineers and operators encountered during intervention in this well. A partially sealing high viscosity tar layer exists between the overlaying oil column and underlying aquifer. Operationally, the challenge was to overcome obstructions arising from tar accumulation during the well intervention. This challenge was overcome by the use of a solvent and the well was successfully acidized with the aid of the CT tractor. The other concern was the tractor integrity while a large amount of acid is pumped and the extended exposure time of tractor to acid. The tractor successfully handled huge amounts of corrosive fluids in a sour environment while providing the required pulling force to reach the TD of the well to set the intervention record for tractor reach without adverse effects on the integrity of its O-rings, seals, and mechanical parts. In addition

to organic deposits, azimuth changes in the well added to well entry challenges as a result of changes in hole inclination, doglegs, and azimuth. The application of real time informed decisions was critical in overcoming all the challenges, optimizing stimulation design, and yielding a notable and consistent injectivity increase with evidence of extended life and a true reflection of deep penetration into the damage zone. The successful reentry will benefit industry operators confronting similar intervention challenges.

Background

An extensive study of the field and its predominant drive mechanism revealed that production and simultaneous peripheral matrix water injection is the preferred depletion strategy. Extended reach wells and relatively complicated trajectories typically characterize the powered water injectors (PWI) drilled for reservoir pressure maintenance. The injectors will support oil production from one of the largest field developments in the history of Saudi Aramco in the M field. The field development consists of 27 artificial islands linked by 41 kilometers of causeway spanning the Arabian Gulf. The blend of onshore, offshore, causeway and artificial island construction concept was the optimal field development option for the field because it results in only 30% offshore development and 70% onshore development. The chosen concept for the field development requires water injection wells to provide peripheral matrix water injection as pressure maintenance strategy to support oil production. A tar mat zone characterizes the field. About 65% of the PWI wells have lengths greater than 17,000 ft, beyond the normal reach of CT.

Introduction

The challenges with coiled tubing (CT) reach in extended reach wells are well documented in the technical literature (Beheiri, et al., 2008). Lockup and weight stacking often prevents CT from reaching total depth (TD) in extended reach wells. The limitation to deploy CT to relatively deep intervals has been challenging for conducting acid stimulation to restore the injectivities of these injectors after drilling and completion (Meshal, et al., 2010). Consequently, operators do not often realize the advantages of CT to enhance the placement and uniform distribution of stimulation fluids across reservoirs in such wells (Nasr-El-Din, et al., 2005). Practical experience with acid stimulation using CT in extended reach wells reveals that beyond the lockup point the remaining stimulation treatment is usually bullheaded at a high rate to the unreached and unstimulated portions of the reserovoir. This often happens after several unsuccessful attempts to get the CT beyond lockup depth. Bullheading a treatment is to forcibly pump the treatment out of the CT into the formation where the CT could not reach. Subsequently, bullheading the stimulation treatment does not guarantee for proper placement of fluids across the open hole because the fluids will typically travel toward the paths of least resistance, usually the most permeable zones, which may not require any treatment (Al-Najim, et al., 2012). As bullheading often has a tendency to concentrate the treatment in the toe or heel of well intervals while leaving the rest of the reservoir without adequate treatment, pinpoint placement with CT from real time monitoring guarantees zone coverage of treatment fluids. The oil industry has addressed this challenge of limited CT reach for stimulation fluids placement through the use of various techniques. Some of these include the use of nitrogen inside the CT to make the CT lighter and make it more buoyant to travel farther, the use of friction reducers, the use of mechanical vibrators, the use of larger diameter CT and more recently, and the use of CT tractors.

Engineers have recently been pushing the envelope with emergent CT tractor technologies especially with respect to improving the maximum tractor pull force and tolerance for H_2S. The CT intervention for the subject well was a phenomenal job of traversing hostile conditions of exposure to acid, uneven borehole, relatively viscous reservoir fluids, and pulling considerable loads to a depth of 29,897 ft, or to put this into perspective – 868 ft longer than the height of Mount Everest at 29,029 ft. Successfully conveying CT to the well's TD means stimulation treatment could also be mechanically diverted with the coil and placed across the open hole. Nevertheless, following the use of CT tractors to convey CT for the successful placement of stimulation fluids, a remaining uncertainty was conducting real time production logging for obtaining the injection profiles after stimulation while simulatenously tractoring to convey CT to the TD of a well.

Attaining the Deepest Rigless CT Intervention Reach at 29,897 ft (9.11 km)

The well intervention involved a CT reach to the deepest open hole horizontal section at 29,897 ft in the M field development and outside the normal reach of traditional tapered CT used for well intervention. Figure 1 shows a cross section of the well. A pre-stimulation assessment involving the evaluation of tubing force models was conducted for the candidate

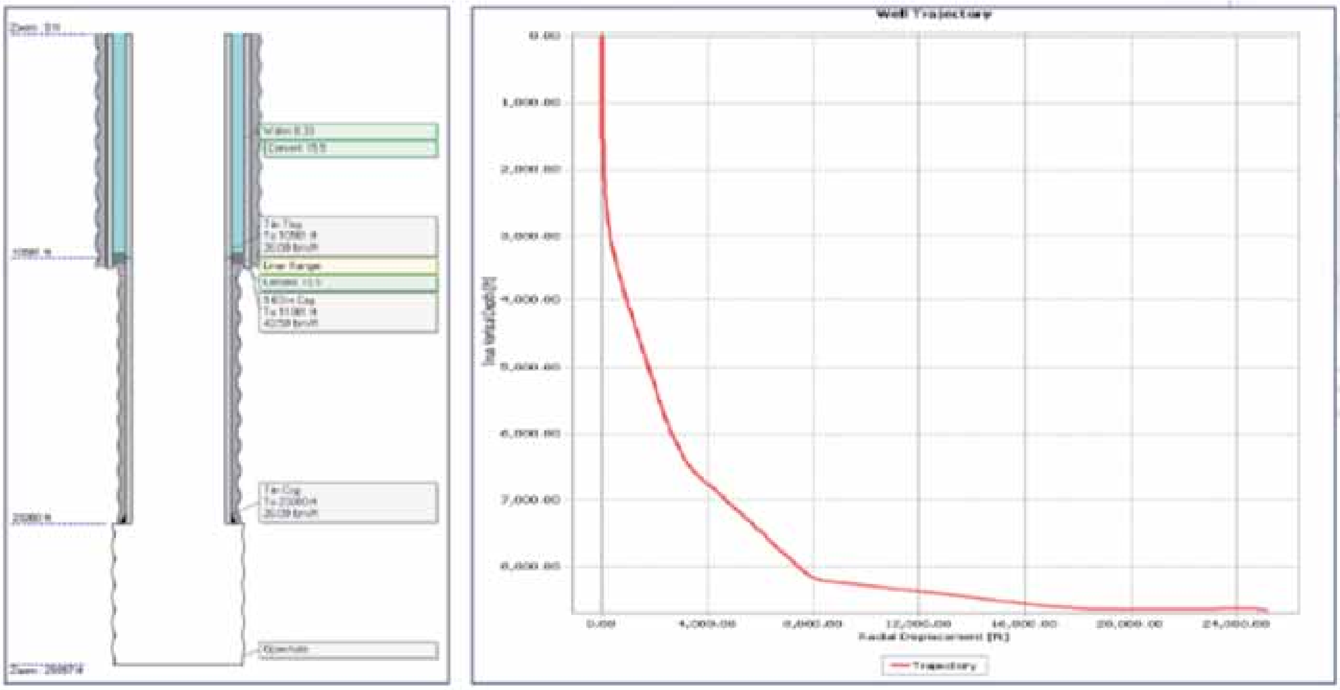


Fig. 1: Well cross section.

well. Usual sensitivity scenarios for CT reach (also referred to as tubing fatigue analysis (TFA)) was performed using coefficients of friction from previous experience on offset wells; however, friction coefficients may change over the life of a well. Consequently, an update of coefficients may be necessary for reliable simulated lockup depths. The TFA scenarios typically include parametric investigation of CT lockup depths with CT alone, with CT and friction reducer, and with CT, friction reducer and tractor. The effect of using tapered or large CT strings, use of vibrators, or buoyancy, and fluid density alteration or modifications was also investigated. The simulation showed that a combination of 2" diameter CT and 4.7" tractor capable of 14,500 lbs pull force would reach 27,869 ft (2,000 ft short of TD), which was the deepest reachable depth as per the simulation runs.

Purpose of the Rigless Intervention

The purpose of the tractor aided CT run was to enhance the gains of CT placement and mechanical diversion of stimulation fluid treatment across the entire 6,697 ft open hole interval from 23,200 ft to 29,897 ft. The basis for well stimulation was the removal of skin caused by mud particle and filtrate invasion from drilling and well completion fluids into the reservoir. The plan was to stimulate all injector wells to enhance well injectivities and ensure favorable waterflood during the injection scheme.

Acid stimulation of the wells is possible with the drilling rig on location utilizing jointed pipe. Nevertheless, at least two issues arise with the decision to conduct the acid stimulation jobs with the drilling rig. First, the incremental cost of performing an acid job with the rig usually results in a much increased total well delivery costs. The second issue is for safety reasons. The reactive nature of HCl could result in a well control issue while tripping out of hole with drill pipe. Consequently, retarded systems and enzymes with delayed reaction times have been applied on the rig with mixed results especially for relatively long reservoir sections. When CT without a tractor is used for extended reach well intervention, CT locks up prior to reaching the well's TD. Partial stimulation often results when the treatment fluid is bullheaded.

Acid Stimulation Design

The design challenge was to carry out a treatment program that generates conductive flow paths between the borehole and the carbonate reservoir in the water injector through acid dissolution or matrix stimulation to counteract near wellbore damage. The choice of a cost-effective stimulation treatment was arrived at following formation compatibility studies, acid spending, and effectiveness of damage remediation. The process involved significant laboratory assessment tests backed by historical operational experience especially to optimize on acid concentration and treatment

Table 1. Pumping schedule (verified or altered according to DTS profile)

		Depth (ft)				Volume	N2 rate	Cumulative
Stage	Step	From	To	Direction	Fluid	bbl	scf/bbl	bbl
1	0	23,200	29,897	RIH	preflush (mutual solvent and water)	962	0	962
2	1	29,897	29,382	POOH	HCL spearhead	37	0	999
	2				Emulsified HCl with diesel	74	0	1,073
	3				HCl spacer	37	0	1,110
	4				Foamed VDA	37	800	1,147
15	53	23,300	23,000	Static	post flush	481	0	3,848

Note: Stages 3-14 are repeat of stages 1-2.

Table 2. DTS schedules usually followed on water injectors

DTS Stage	*Procedure*	*Comments*
DTS-1: Baseline	DTS-1 is acquired as soon as CT reaches the Well TD or maximum depth. Data acquisition requires 2 to 3 hrs.	Avoid disturbing wellbore temperature before acquiring baseline. If pumping is required, keep to minimum rate and volume. This will create a temperature profile reference for the wellbore.
DTS-2: Treated Water Bullhead Injection Monitoring	With CT at maximum depth, bullhead [1 to 2 open hole volume] treated water down the annulus CT tubulars while monitoring DTS acquisition. DTS data acquisition is based on pumping time.	Pump at maximum constant rate below fracturing pressure. This will allow identification of intake zones next to the heel and assess other laterals' intake, when present.
DTS-3a: Post Bullhead Warm-back	Continue monitoring temperature of wellbore after pumps are shut-down, keeping CT stationary at max depth. Data acquisition requires 2 to 3 hrs.	Do not pump fluids, do not open or disturb the well while monitoring DTS. This will allow identifying intake zones.
DTS-3b: Post CT Injection Warm-back	If previous DTS does not show fluid intake at the toe, then inject [1/2 lateral volume of treated water] via CT while keeping CT stationary at max depth. Acquire warm-back DTS for 2-3 hrs.	Injection should take place with well shut-in at surface. This will allow the identification of the intake zones next to the toe, and the non-reached interval due to lock up/tag.
Decision Making Stage	Based on the previous DTS results, decision is made to adjust the pumping schedule with required stages of diverter, acid and CT reciprocation.	Stimulation targets are identified as the zone with high hydrocarbon saturation on the logs but with low injectivity on DTS profiles.
Stimulation using fiber optics	Perform matrix stimulation following adjusted pumping schedule.	Rates, volumes and CT reciprocation must be acquired and documented.
DTS-4: Post Diverter-Acid Injection Warm-back	After each stimulation stage (diverter-acid), return CT below stimulated zone to perform DTS warm-back acquisition for 2 hrs.	Displace CT with non-reactive fluid. Keep the well shut-in. This allows assessment of the acid coverage and diversion efficiency.
Decision Making Stage	Re-adjust pumping schedule based on last DTS results and plan for next stimulation stage as required.	Repeat DTS-4 as required.
DTS-5a. Treated Water Bullhead injection Monitoring	With CT at max depth, bullhead [1 to 2 open hole volume] of treated water down the annulus CT-Tubulars while monitoring DTS acquisition. DTS data acquisition is based on pumping time.	Use constant pump rate similar to expected injection rate in the well. Rates and volume must be acquired in a tally when third party pumps are used. This will allow final assessment of stimulation results.
DTS-5b. Post Bullhead Warm-back	Continue monitoring temperature of wellbore after pumps are shut-down, keeping CT stationary at max depth. Data acquisition requires 2 to 3 hrs.	Do not pump fluids, do not open or disturb the well while monitoring DTS. This will allow final assessment of stimulation results.

volumes per foot of open hole interval. Ideally, the assumption of uniform porosity and permeability spread in the reservoir imply that all sections of the reservoir would require the same volume of stilation fluids. Nevertheless, actual variations of porosity and permeability resulting from heterogeneity along the carbonate reservoirs inherently complicate stimulation operations and invalidate simplistic assumptions. Variable lateral and vertical reservoir anisotropy, complex porosity distributions, natural fractures, and irregular flow paths in carbonates mean that diversion techniques should accompany huge volumes of treatment fluids used in stimulation treatment required for effective zone coverage.

Design optimization based on extensive tests and validation from field trials resulted in a treatment schedule involving a preflush stage, multiple main treatment stages, and a postflush stage. The preflush and postflush stages consist of mutual solvent and water. Mutual solvents in the form of ethyleneglycolmonobutyl ether (EGMBE) serve to remove heavy hydrocarbon deposits, especially from the high viscosity tar controlling the wettability of the wellbore before or after the stimulation treatment, and breaking or preventing emulsions. The main stage comprise HCl spearhead, emulsified HCl with diesel, HCl spacer, and foamed Viscoelastic Diverting Agent (VDA) system. The HCl in the main treatment provides the reaction with the minerals dolomite CaMg $(CO_3)_2$ or calcite ($CaCO_3$) to enhance the injectivity of the reservoir. Emulsifying the acid with diesel significantly retards the HCl to minimize immediate spending of the reactive acid in the carbonate reservoir face. This typically produces better wormholes and conductivities than conventional acid at the same matrix conditions. The VDA system is a polymer-free chemical diverter. As a result, when energized with nitrogen, the system significantly improved zonal coverage of stimulation fluids, while leaving minimal residual damage from the treatment. The VDA temporarily forms a high-viscosity barrier, which breaks by dilution with formation fluids. The VDA is nitrified to form foam of given quality, which helps to interfere with the natural tendency for injected fluids to take the route of least resistance (i.e., the highest permeability zones). Other chemical diverters with industry applications include crosslinked polymer gels, bridging agents such as benzoic acid flakes, and nitrogen foam. Although these diverters could sometimes be quite effective, chemical residues or incorrect application may result in formation damage and reduction in injectivity. The initial pumping schedule prior to acquisition of any distributed temperature profile is as listed in Table 1.

Acid Stimulation Treatment

Stimulation treatment on the well was a 15-stage treatment that was optimized by acquiring a continuous temperature profile from distributed temperature sensing (DTS) measurement data.

DTS is utilized via real-time interpretation and optimization of downhole measurements through fiber optic profiling so as to monitor acid treatment, diversion, or placement during the stimulation jobs in the carbonate formation. It works on the following principle:

Inert fluid shows more cooling in high permeable thief zones than the rest of the zones via DTS and the opposite is the case when acid is pumped into that zone, i.e., it shows higher temperature than the rest and is caused by exothermic reaction between acid and carbonate. Table 2 shows the following DTS schedules that are usually followed on water injectors like the subject well.

.Step #1: DTS-1 Baseline

Prior to stimulation, a DTS profile was established called DTS-1, i.e., Baseline DTS. The baseline DTS is to get the well geothermal temperature with minimal disturbance in an attempt to reach the wells TD or maximum reached depth. This is why it is recommended to pump the minimum volume of fluids while reaching the wells TD/maximum reached depth. The baseline DTS is shown in Fig. 3. DTS was recorded in January 2012 for about 2 hours. The following observations are made from the Fig. 3:

• Baseline acquisition started at 29,632 ft after tagging at 29,673 ft.
• Total volume of 1,136 bbls of seawater-solvent mixture was pumped to tractor down to target depth.
• Warmback effect was present across all of the horizontal section.
• Warming up magnitude was higher at the toe than the heel (can be apparent).
• Green line refers to the single baseline. It also shows that it was the start of baseline recording in January 2012.

Step #2: DTS-2: Treated Water Bullhead Injection Monitoring

While keeping the CT at same depth as in DTS-1, injectivity test was conducted with 1,505 bbls of seawater while injection rate steadied at 5 bpm.

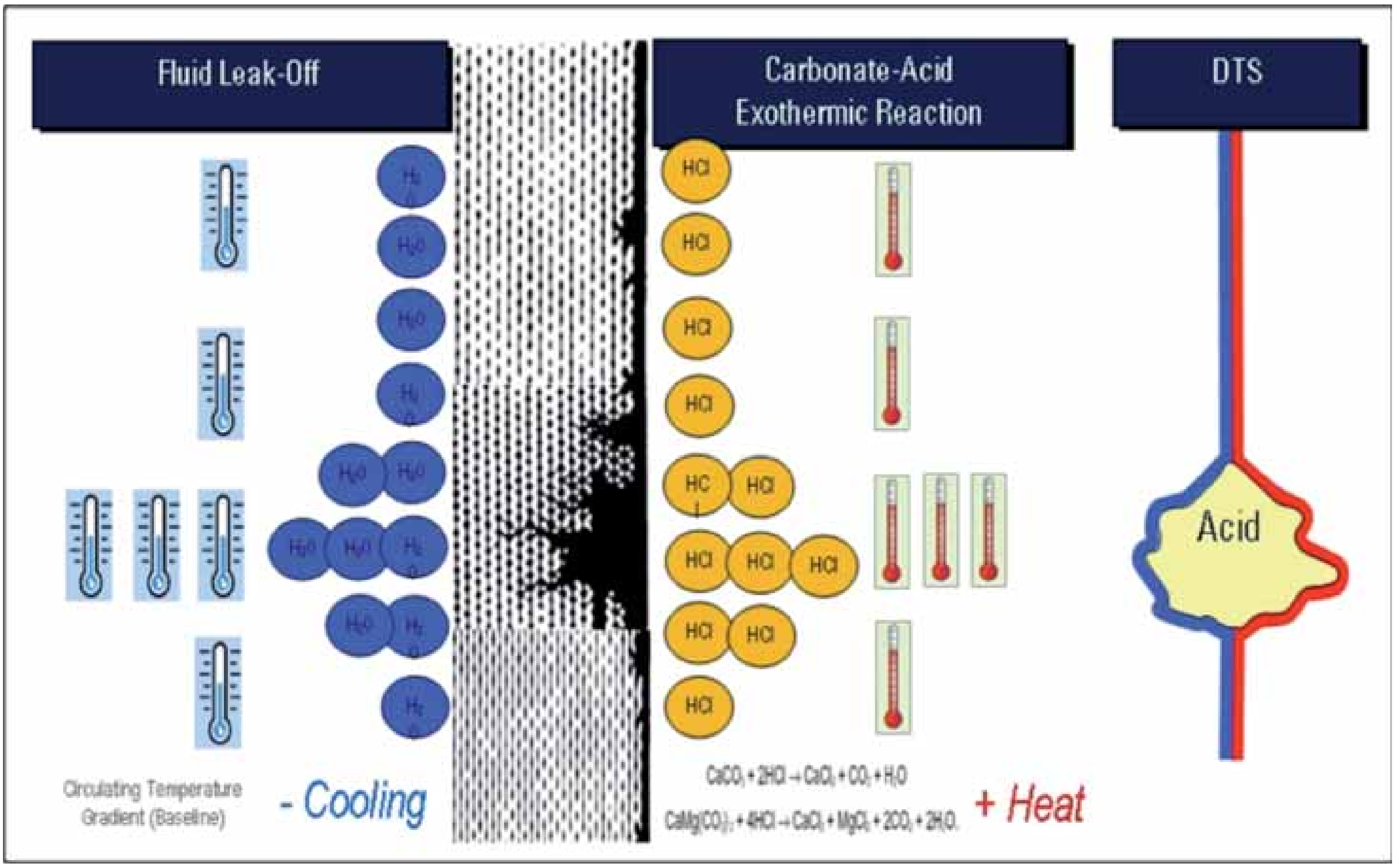


Fig. 2: DTS principle for high permeable thief zones identification via fiber optics.

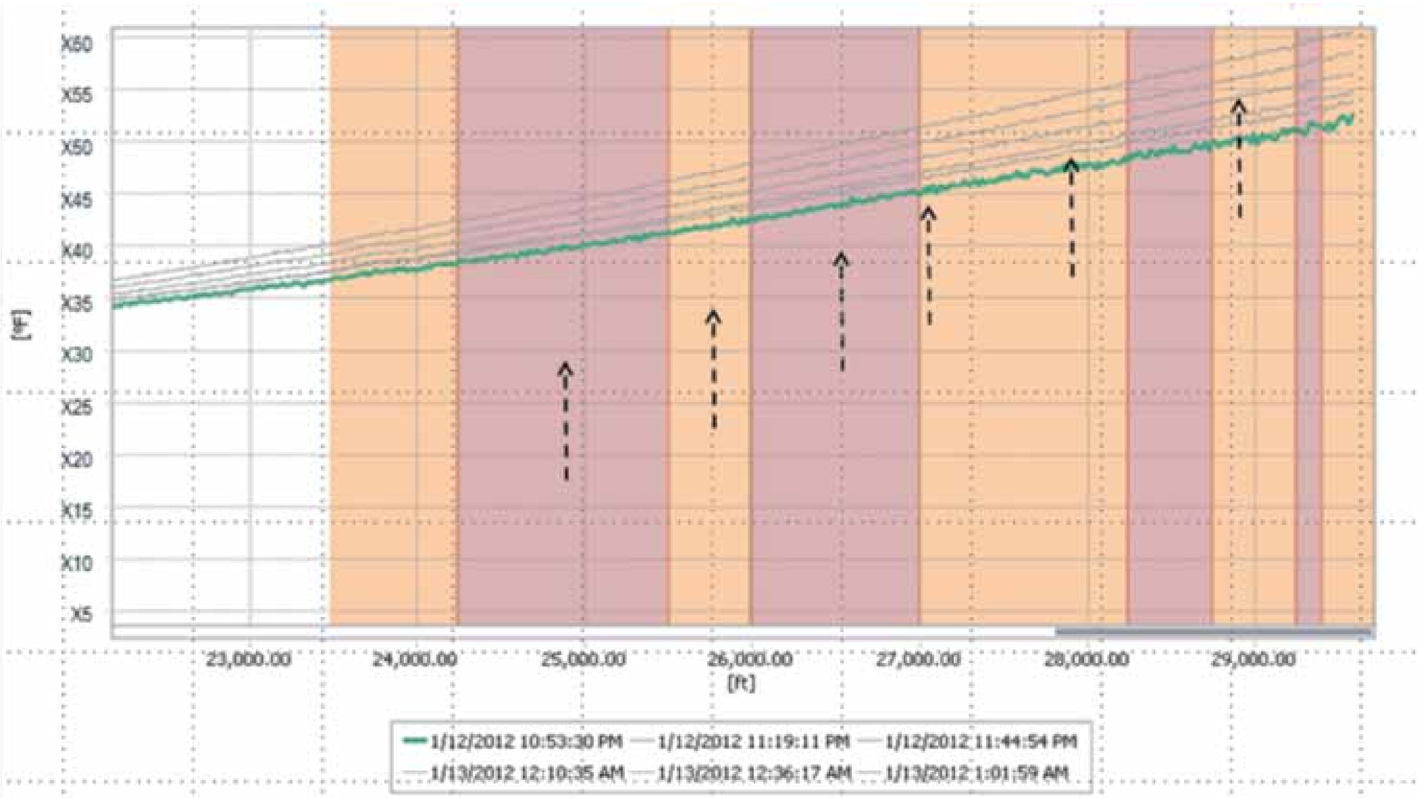


Fig. 3: DTS-1 baseline data. The single baseline is colored green.

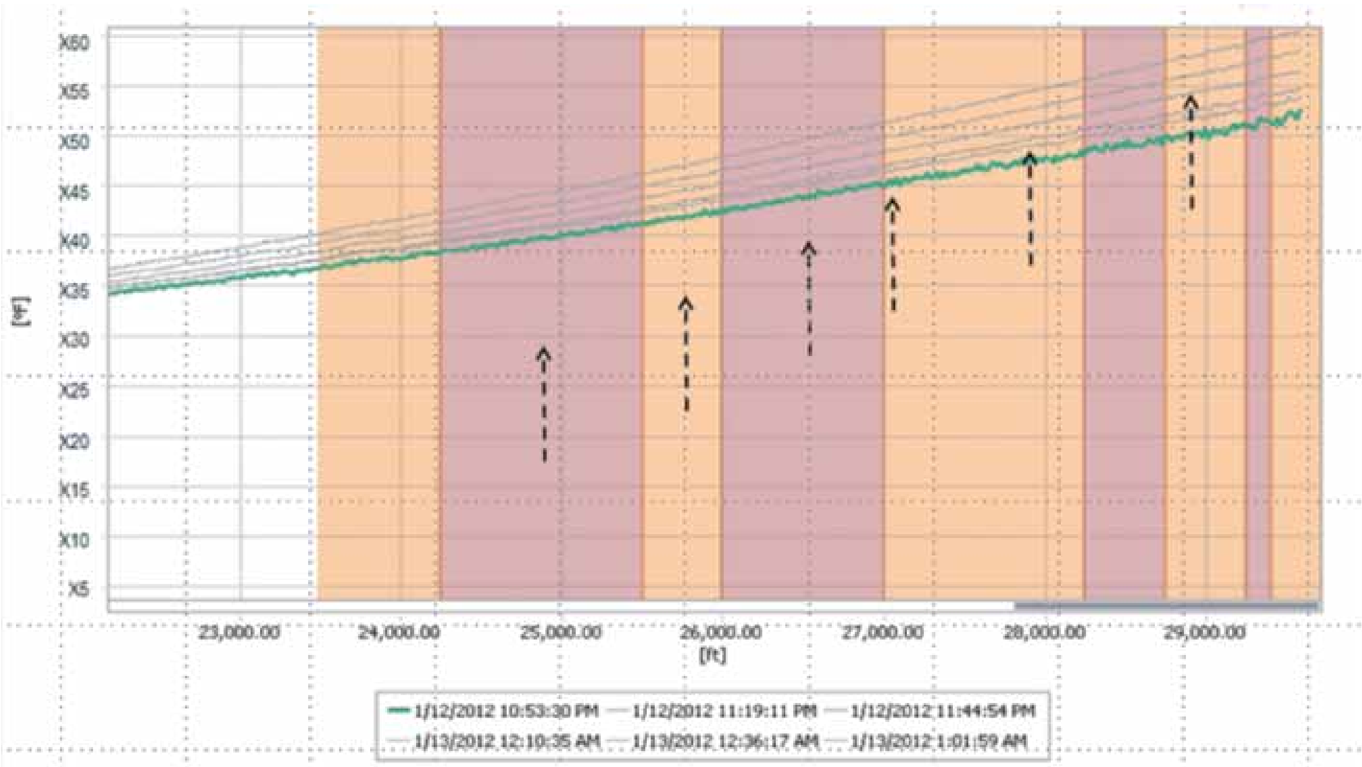


Fig. 4: DTS-2, bullhead injection monitoring.

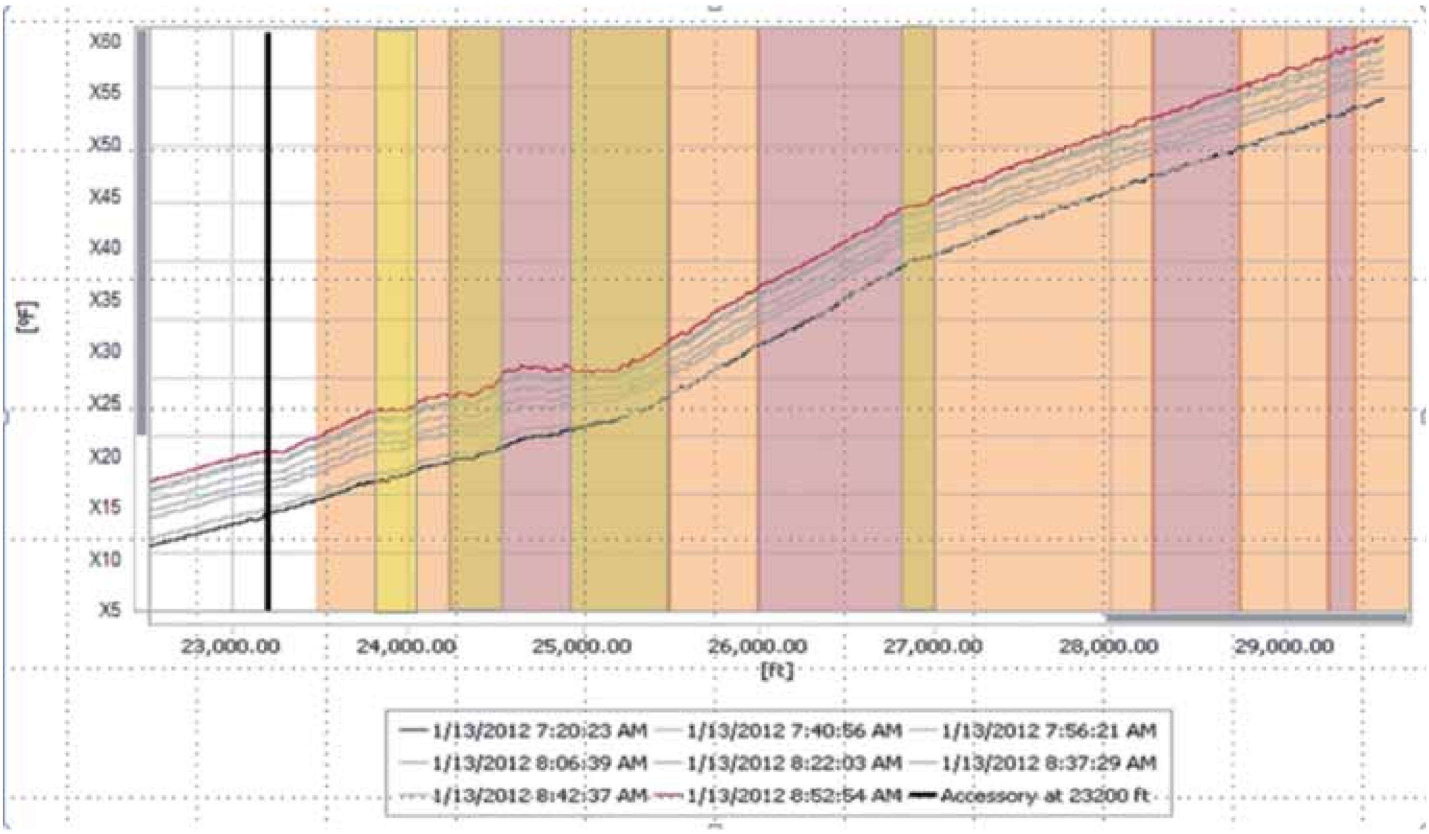


Fig. 5: Post bullhead warm-back

Cool-down traces were obtained from DTS data and a preliminary injectivity index calculated. After identifying high intake zones, a revised pumping schedule was followed while keeping cumulative volumes constant so as to optimize acid treatment placement. Figure 4 shows DTS traces obtained as a result of injection. The following observations can be made from Fig. 4:

• Bottom-hole temperature (BHT) measured at the temperature tool on the end of the coil was steady at 226 °F, which means that the volume bullheaded down the tubing did not reach the end of the bottom-hole assembly (BHA).
• Some confidence in DTS traces up to 27,000 ft.
• All cool-down traces were actually higher than the base line profiles denoted in green.
• Black line was the first acquired profile, while the blue was the last/coolest one.
• Preliminary Injectivity Index was 91 bbl/d/psi.

Step #3: DTS-3a: Post Bullhead Warm-back
Once injection and its monitoring via DTS finished, CT was kept at same depth and formation warm-back was observed as presented in Fig. 5. The following observations can be made from Fig. 5:

• Warm-back traces were acquired throughout the mixing time for the main treatment.
• The plot above was for the first 2 hours of temperature profiles.
• High intake zone were identified (to an extent!) as follows:

– 23,850 to 24,120 ft
– 24,254 to 24,705 ft
– 24,938 to 25,510 ft
– 26,840 to 27,040 ft

While waiting for the site interpretation team to identify high leakoff zones for an optimized diversion schedule of acid treatments, CT was reciprocated as permitted to avoid differential sticking from CT lying on the low side of the hole.

Decision Making and Fiber Optic Enabled Stimulation:
For the acid treatment, CT was pulled out of hole while 17.5% HCl and emulsified acid were pumped starting from the well TD at a reduced loading of 2 gallons per foot (gpf) and 4 gpf for the tight or damaged zones, respectively, while foamed VDA-Visco Elastic Diverting Agent diverter was increased to 6 gpf loading at the high intake/high permeable thief zones. In the rest of the intervals, an increased loading of 7 gpf was maintained for emulsified acid with 2-3 gpf maintained for VDA. Treatment rates down the CT were between 1.3 bpm and 2.0 bpm. The use of nitrogen helped to optimize acid volume requirements, assisted with better zone coverage from diversion, and reduced acid leak off. Regular pull tests were conducted to assure no restriction in the CT path and that the CT is free. As soon as lockup occurred the tractor was activated. Pressure drop across the tool when stationary was about 1,500 psi and 1,300 psi while tractoring. Capabilities of DTS measurement allowed a validation of the optimum zone coverage with treatments that ensured the spotting of acids or diverters where necessary.

Figure 6 displays a complete record of events for Run #1 with real time logging and CT reach to 23,587 ft while overcoming tar issue with solvent. Figure 7 captures a complete summary of events for Run #2, inclusive of CT stimulation and CT reach to 29,581 ft.

Problems Encountered and Lessons Learned

Tar issue was a major concern during the first run as it led to lock up at 13,233 ft. Pumping a solvent mixture helped to overcome the restriction caused by tar, allowing tractor activation to 23,587 ft (> 6,300 ft shallow from TD) before another lockup occurred. Spotting organic blend treatment to address the tar issue significantly reduced the coefficient of friction, especially in the casing from 0.33 to 0.25. As a result, the stimulation job was executed to TD after a second run to the well's TD at 29,897 ft.

Variation of fluid density and circulation pressure in the CT, wellhead pressure, stripper friction load, reel break tension, and pipe design configuration probably account for variation in friction coefficients and differences between simulated and actual CT lockup depth.

The First Application of Real Time Logging Enabled Through a Wired Motor Head Assembly via a Tractor

The utilization of wireline tractors to enable well interventions for production surveillance, or assessment of well integrity in horizontal or highly deviated wells has become common knowledge within the oil industry especially with the increasing application of extended reach wells. The use of CT tractors as tool deployment alternative for these complex and horizontal wellbores is a relatively emergent technology that has continuously

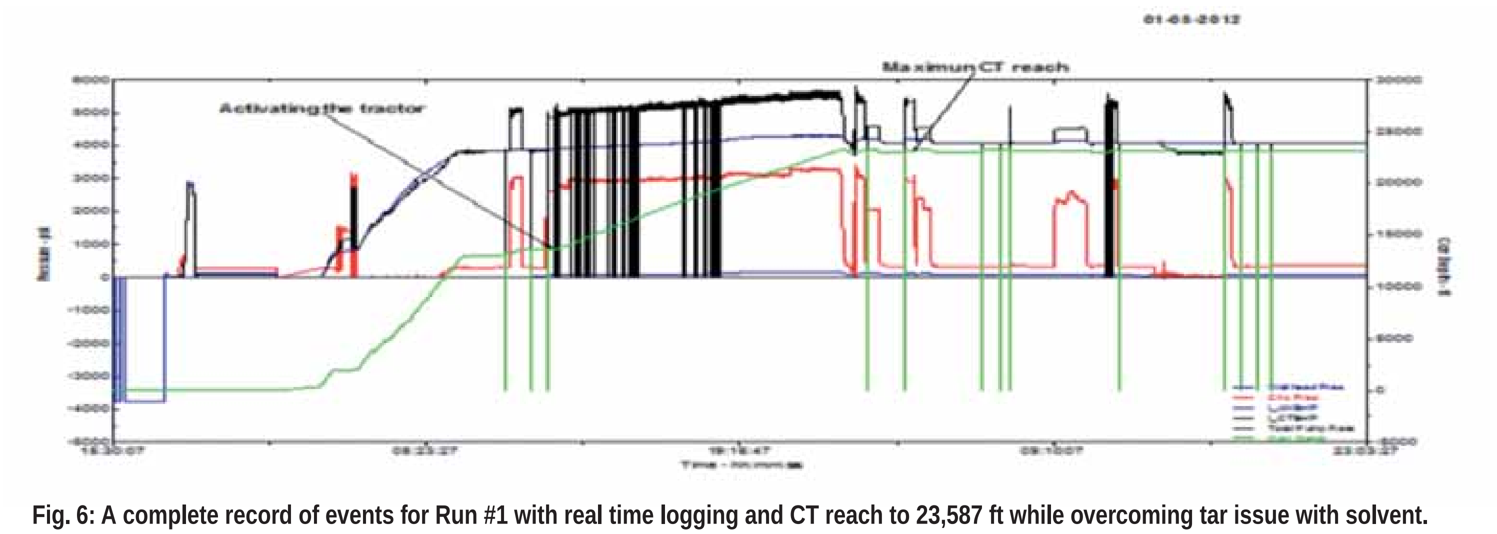


Fig. 6: A complete record of events for Run #1 with real time logging and CT reach to 23,587 ft while overcoming tar issue with solvent.

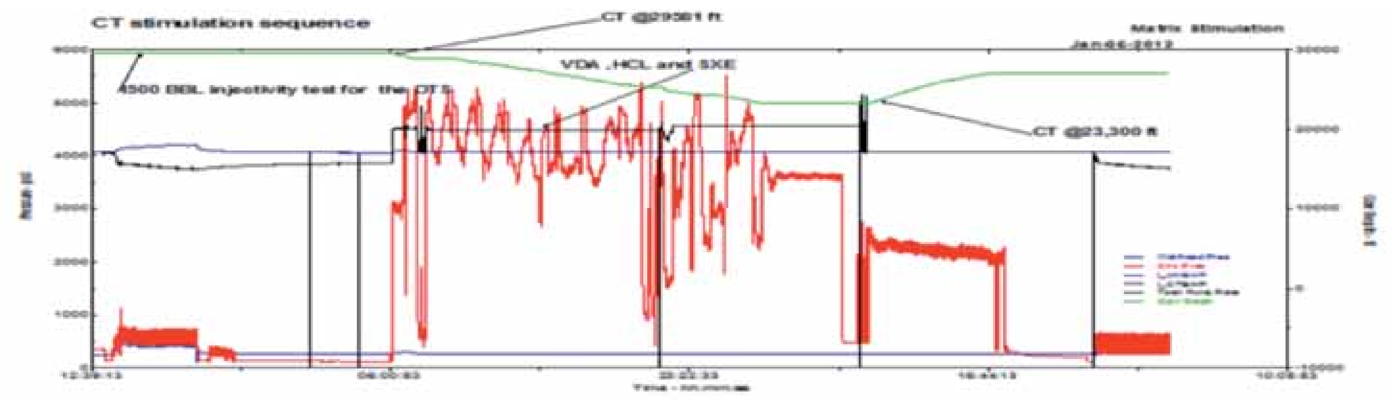


Fig. 7: A complete summary of events for Run #2, inclusive of CT stimulation and reach to 29,581 ft.

evolved recently. CT tractors have been used fairly extensively both to improve CT reach beyond the lockup depth and to deploy tools in the M field. Solid experience on over 30 horizontal applications in the M field has been critical to job improvement and planning.

Technically, the production log is useful as a reliable tool to verify the effectiveness of the stimulation job and to confirm geological or engineering analysis and assumptions. The reservoir management team may overlook downhole condition changes without comprehensive, interval-by-interval information from quantifying downhole flow in the wells. This could result in lost production for reasons other than poor transmissibility between the injector and the producers or usual depletion in the oil reservoirs. Therefore, the production log may help to correlate production results with injection profiles for acceptable sweep efficiency of the planned waterflood. Acquiring quality injection log profiles allows the team to document a baseline injection profile for the injector wells for future reference. Also based on information obtained from production logs, some wells can frequently be profitably reworked or recompleted to improve their injectivity. Therefore, the production logs would assist with reservoir management of the reservoirs, especially during the depletion phases and offer critical guidance in the design of remedial workovers. Acquiring reliable data from production logs in the wells allows precise and accurate design of remedial workover procedures. These guide to more cost-effective and efficient well recompletions, and, occasionally results in workover designs that would otherwise be impossible. The production log is also an important tool for future planning to significantly improve the economics of a project. Reliable data from the log could result in different completion practices for upcoming wells or even assist in the design of new wells. Its immediate value in evaluating the completion efficiency and positive identification of the actual injection intervals is also important. The value of a conclusive real time identification of water entry points in the injector well has been established in the field, especially after previous data quality issues with memory production logging tools (PLTs) in challenging wells. Although tractor interventions have proved to be the preferred deployment method for extended well stimulation, there still existed the uncertainty of conducting real time production logging while simultaneously tractoring. Focusing on overcoming this challenge resulted in the first industry trial of real time Electrical to Optical production logging measurements simultaneously with the running of a tractor.

Fiber Optic Enabled CT (FOECT) System with Hydraulic Tractor for Real Time Production Log

The fiber optic enabled CT (FOECT) system consists of fiber optic cable encapsulated in a 0.125" steel tube offering mechanical protection and fed through the entire CT reel. The fiber is fed through the BHA including the tractor and connected to the optical logging adapter, which houses a battery providing the power to the PLTs below.

A primary objective of the production logging in the PWI was to evaluate the effectiveness of the stimulation treatment in the reservoir, a production log allowed for accurately defined distribution of the injection fluids, identification of unproductive intervals and detection of well damage as a function of depth and to quantitatively measure the downhole flow rate. With peripheral matrix water injection as the planned pressure support mechanism for the field, assuring adequate pressure support through water injectors to the oil producers is essential. Consequently, it was important to ensure good water injection profiles in the PWI. A FOECT reel with hydraulically powered tractor was selected as the preferred method for a real time production log in an extended reach well. Alternative options were limited and are discussed below.

Memory production logging: Risk of spinner being damaged or plugged in open hole section and little or no data recovered when survey was completed, with surface read out mode, attempts could be made to unblock the spinner by running at faster speeds or abandoning the survey at an earlier point saving on operational time.

Surface read out electric line production logging: Utilizing electric cable in the CT would not allow for pumping acid through the coil due to the corrosive exposure to the wire, which would require two different reels and would also have increased the total weight for any tractor to pull.

Electrically powered tractor: Limited pulling force with existing types and again there is no possibility for pumping acid through the coil with the electric cable installed in the reel.

A downhole vibrating tool: Simulation showed that using this tool would result in being several thousand feet short of tagged depth, this tool can also increase the risk of damaging electronic logging tools with the excessive vibrations.

None of these options provided the ideal solution to logging the extended reach horizontal well. The option of combining the existing technologies of hydraulically powered tractor and fiber optic enabled real time production logging was the obvious choice to achieve the best results. Simulations showed that utilizing a hydraulically powered tractor on CT would enable the coil to reach the maximum depth. Technically the challenge of combining the tractor with fiber optic enabled production logging could be overcome with existing tools and the modification of existing technology and tools. Figure 8 shows that the BHA where the fiber optic cable was fed through the bore of the tractor and made up to the optical logging adapter with the standard PLT string on the bottom. The flexibility to perform real time quality control of the PLT become an attractive feature as it allowed for making any required alterations to a logging program. For example, on a previous production memory mode log run on an earlier well, a spinner failure from tar drop-outs in the wellbore was not identified until the memory PLTs were retrieved upon rigging down. Therefore, apart from the lost time, the loss of data was a major issue with running memory PLT in the PWI wells as another log could not be run without a significant effect on the stimulation schedule. From this experience evolved the decision to run real time production logs in problematic wells with potential for triggering data problems. Against this backdrop, further optimizations resulted in the choice of real

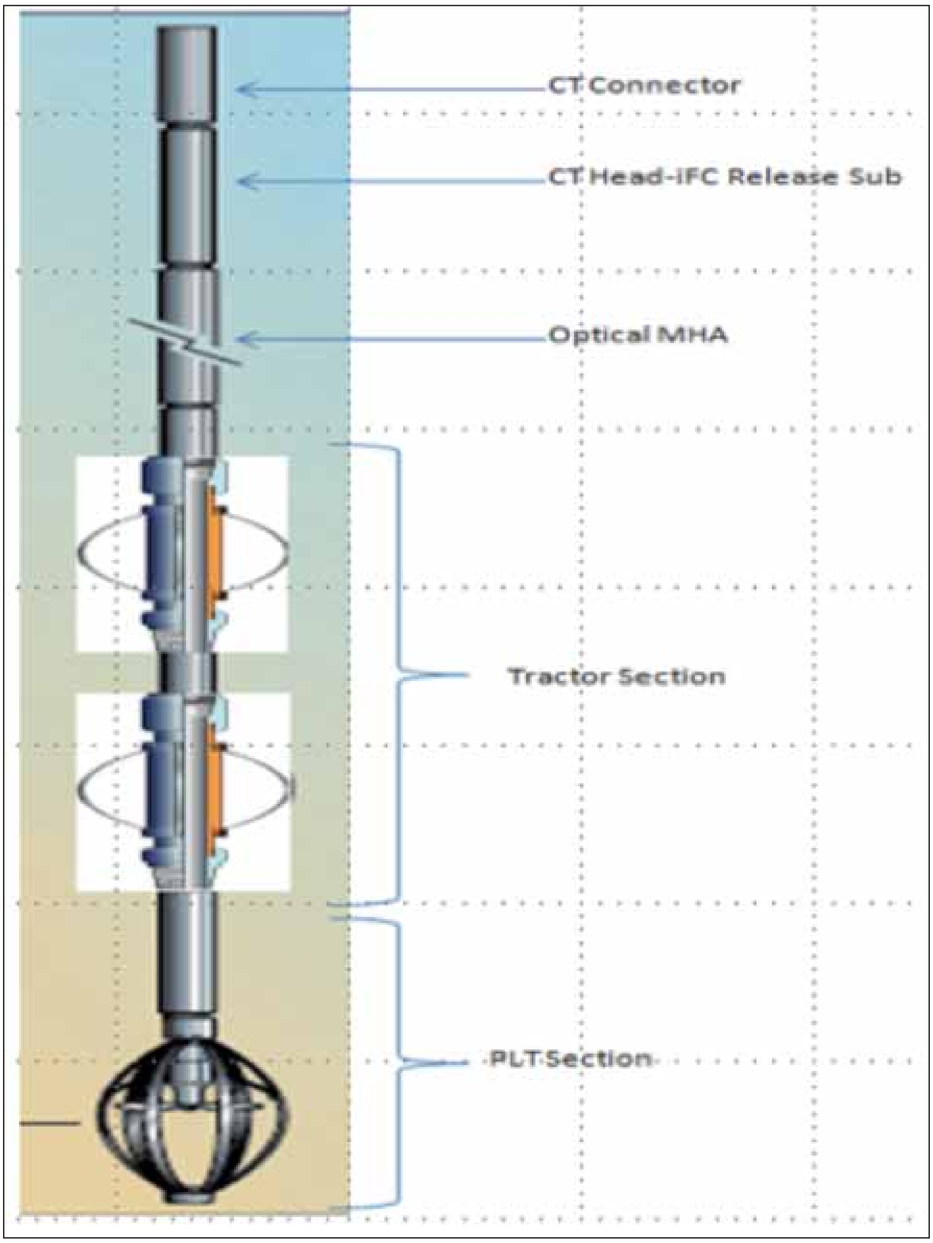


Fig. 8: PLT configuration.

time production logging via a FOECT. The first FOECT was performed in the field to acquire real time production logging data. The system enables logging and stimulation interventions without separate trips for each intervention. Telemetry for the production logging is conveyed by wireless optical data from the working reel to a data acquisition system on surface. The process does not require any standard logging unit.

Tool Configuration and Description

The FOECT system was designed to use standard electric line logging tools giving an advantage of readily available stock of proven tools. The optical logging adapter then converts all the logging tools electrical signals for optical telemetry through the fiber optic cable. The single phase condition allowed for a basic set of logging tools to be run as listed here:

• Gamma Ray Tool – Primarily used for depth correlation against reference log.
• Temperature Tool – To measure high resolution accurate BHT.
• Pressure Gauge – To measure high resolution accurate bottom-hole pressure (BHP).
• Casing Collar Locator (CCL) – CCL was used for depth correlation against completion. It works through the variation of the magnetic fields of magnets as the tool traverses through several metal thicknesses (Note: A casing of known thickness has a constant magenetic field).

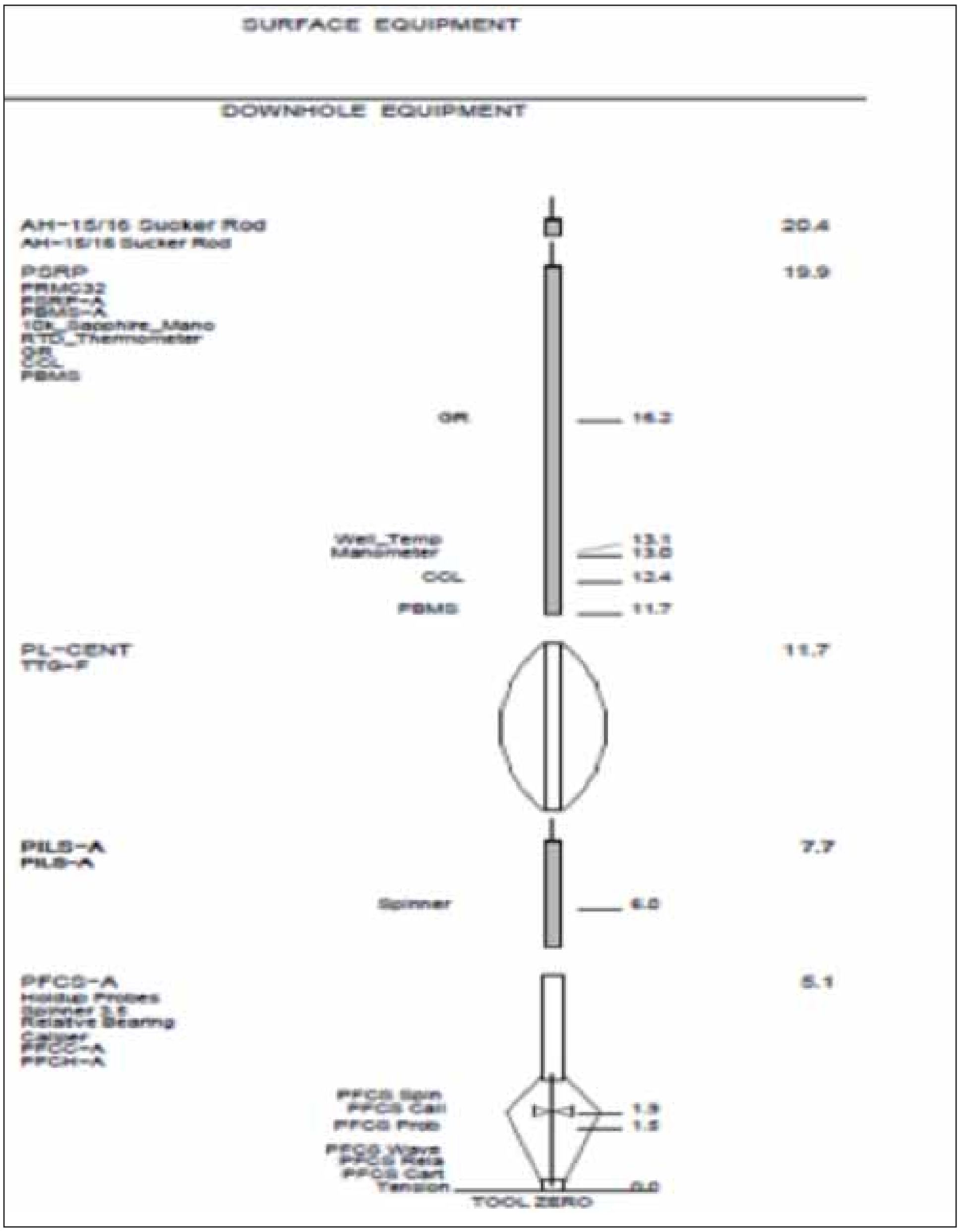
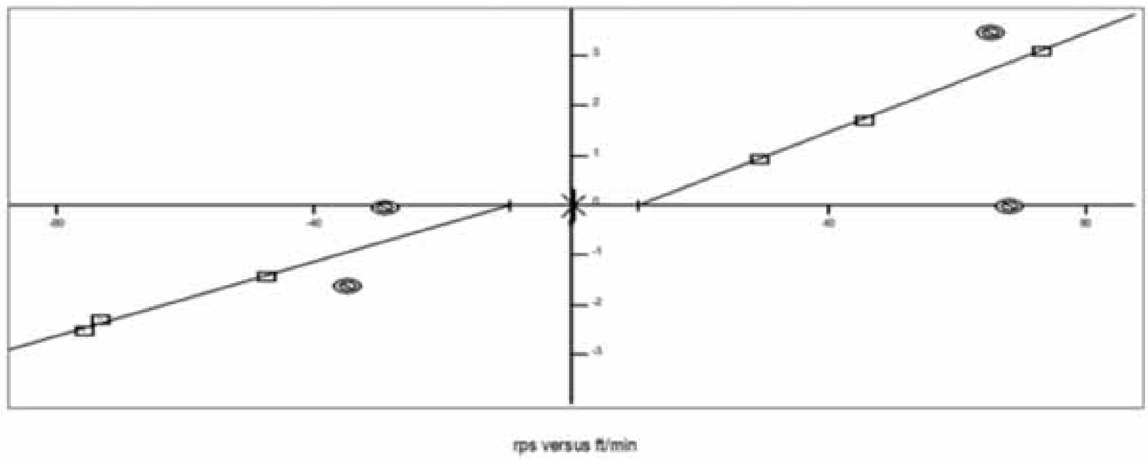


Fig. 9: Downhole production logging equipment.

• Inline Spinner – To measure bottom-hole fluid velocity and back up to full bore spinner.
• Caliper – To measure diameter of open hole section.
• Full Bore Spinner – To measure bottom-hole fluid velocity.

Figure 9 shows the logging tool configuration. Ideally a spinner blade to cover as much of the cross-sectional area as possible would be used and for 7" liner a spinner blade size of around 4" would be standard. Previous field experience revealed that there is a high risk of damaging the blade and plugging exists if this size of blade was used in the open hole section. A 2" spinner blade was found to be the optimal size in the trade off between data quality and operational success.

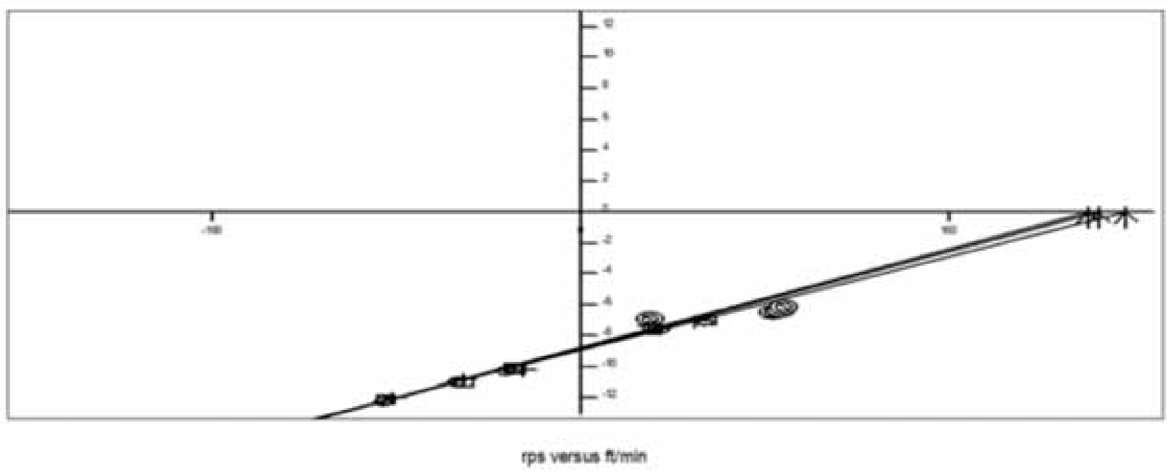
An ideal production log with most reliable results would be carried out with multiple passes made over the logging interval at different logging speeds and in different directions. A standard production log would be carried out at 30, 60 and 90 feet per minute (fpm) in both down and up directions. In the case of this extended reach well, a multi-pass PLT was not practical due to time constraints and tractoring limitations. Consequently, a single pass was considered adequate due to the linear response of flow meters in single phase fluids and with multi-pass calibrations being made in the liner section. For a production log survey, the best quality spinner data is normally found in the log passes conducted in the opposite direction to the fluid flow, we would therefore expect the up pass for



Spinner SPIN

Calib. Zone ft	Slope (+)	Slope (-)	Int (+) ft/min	Int (-) ft/min	Int. Diff. ft/min	Thr. (+) ft/min	Thr. (-) ft/min
▭ 19118.2-19148.4	0.050	0.037	10.24	-9.69	19.93	10.00	-10.00

Fig. 10a: Spinner shut in calibration plot.



Spinner SPIN

Calib. Zone ft	Slope (+)	Slope (-)	Int (+) ft/min	Int (-) ft/min	Int. Diff. ft/min	Thr. (+) ft/min	Thr. (-) ft/min
▭ 21990.2-22004.7	N/A	0.037	N/A	237.85	0.00	0.00	0.00
⬭ 22074.0-22079.6	N/A	0.040	N/A	221.06	0.00	0.00	0.00
+ 22184.2-22191.0	N/A	0.039	N/A	226.52	0.00	0.00	0.00

Fig. 10b: Spinner injection calibration plot.

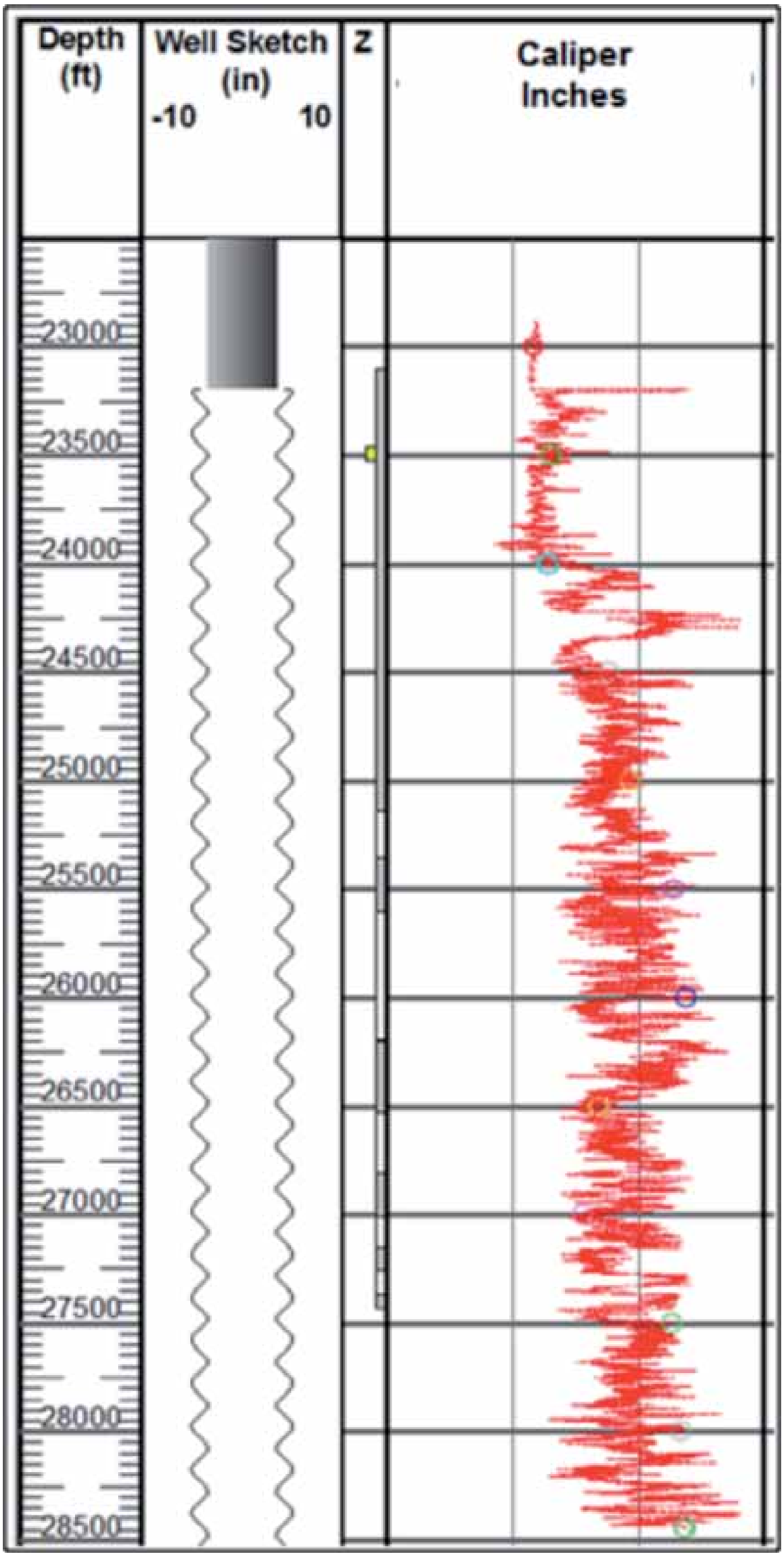


Fig. 11: Caliper log.

an injection well to provide the best spinner data. Furthermore, with CT, the up pass is also smoother in terms of pulling speed than running in hole, which can be erratic, especially in long open hole sections.

Spinner Calibration

To be able to convert the spinner speed (rotations per second (RPS)) into fluid velocity, a calibration is required for the spinner to find the spinner response and threshold of the tool. The shut-in and injection calibration passes were conducted in the horizontal section of 7" liner where the injection rate was constant and the hole size was fixed, the depths were chosen above the simulated lockup depth to allow the passes to be done without tractor activation but close to actual logging conditions.

The threshold velocity is the minimum fluid velocity required to start the spinner turning to overcome friction forces in a fluid, the spinner response calibrates for the specific fluid type for density and viscosity, which affect the response of the spinner. Figures 10a and 10b show the spinner calibrations.

Vapp = Spin/m - Vt – Cs
Vapp = Apparent Fluid Velocity fpm
Spin = Spinner RPS
m = Slope from calibration of spinner response (RPS/fpm)
Cs = Coil speed (fpm)
Vt = Threshold velocity of the spinner (fpm), found from the intersect on the X-axis in no flow condition.
Vav = Vapp x Cf
Vav = Average Fluid Velocity (fpm)
Cf = Correction factor, to account for non uniform shape of velocity profile and based on spinner size to hole size ratio. (unitless)

Caliper Log:

The fluid velocity is affected by the hole size and must be accounted for, the caliper was used to give a complete log of the wellbore inside diameter and is particularly important in the case of irregular sized boreholes as seen in Fig. 11.

A volumetric flow rate can now be calculated as follows:

Q = CSA x Vav
Q = Volumetric Flow Rate (RBPD)
CSA = Cross sectional Area (Diameter taken from caliper readings in open hole)
Vav = Average Fluid Velocity (fpm)

Design Considerations

The system was designed to use standard electric line logging tools giving the advantage of a readily available stock of existing proven tools. The optical logging adapter converts all standard electrical signals to optical for data transmission through the fiber optic cable.

The test was designed using a relatively high injection rate of around 10,000 bbls/day of treated water. A high rate is desirable to achieve quality data with more reliable flow meter operation. The high rate would result in having most of the logged section in a turbulent flow condition leading to a more linear response for the spinner and be more likely to avoid any blockages to the flow meter and overcome any mechanical friction forces that could cause the spinner to stick at lower rates. Single phase flow is the simplest form of flow regime to interpret without much of the complexities that exist in multiphase flow; fluid viscosities and densities remain constant leading to linear spinner responses across the logged interval. Under flowing conditions the flow regime is either laminar or turbulent, laminar flow occurs in low energy and turbulent in higher energy states. The shape of the velocity profile across the hole diameter for laminar flow is parabolic with the highest velocity in the center, whereas the velocity profile for turbulent flow is much flatter with the highest velocity still in the center but much closer to the average velocity due to the flatter profile. The centralized spinner will therefore read closer to average velocity in a turbulent flow regime, in either case of laminar or turbulent flow a correction factor is applied to correct the nonuniform nature of the velocity of the fluid flowing along the open hole.

Logging Operations

After the surface checks on the PLTs, the CT lubricators and injector head were pressure tested prior to running in hole. The tractor was successfully function tested at 2,000 ft and the PLT string was run in hole carefully monitoring weights, pumping friction reducer and conducting pick up weights every 1,000 ft. The shut-in calibration passes were conducted in the 7" liner at 30, 50 and 70 fpm in both directions. Logging commenced downwards for shut-in conditions across the open hole. Upon lockup at 23,830 ft, the tractor was activated and logging continued. Weight loss was experienced at a depth of 28,445 ft, the coil was stopped immediately to avoid any physical damage to the PLTs. The tools were checked via surface communication, with all indications that the tools were still in good operational condition. The decision was taken not to risk continuing to run in hole and to stop the logging at the held up depth of 28,445 ft only. The injection of treated water commenced from surface down the tubing at approximately 10,000 bbl/d, a constant stable pump rate was observed on surface, with the BHP, temperature and spinner rate monitored until conditions were stabilized. Once conditions were stable, uphole logging commenced for the main pass at 30 fpm into the 7" liner. After a stabilization period, injection calibration passes were conducted at 30, 50 and 70 fpm in both directions. Upon completion of the production log, the tools and equipment were rigged down.

Results

The interpretation of the production log entailed a review of all the data gathered. The main objective for using production logging was to achieve an injection flow profile along the entire length of the wellbore. The data was used to analyze the effectiveness of the matrix acid stimulation, as a baseline log and also to compare against the open hole logs. There was a strong correlation between the open hole log data and the flow profile obtained from the production log. The tight zones shown from the drilling logs matched up with the flow profile taken from the PLT with little or no water injection events. The zones with, high permeability, well developed porosity and good mobility matched with the high intake zones shown from the PLT injection profile. There was, however, some divergence over a section of the open hole where the drilling logs had indicated high intake zones but the production log showed no injection happening indicating the stimulation may not have been effective over this zone. Although the acid matrix stimulation was shown to be a success in terms of overall increase in injectivity with a large reduction in skin, the production log was the only method that could accurately determine the injection profile, identification of unproductive intervals and detection of well damage.

Conclusions

The operation proved the concept and demonstrated the benefits of real time production logging with a hydraulic tractor in an extended reach open hole horizontal well during stimulation with acid treatment. The real time logging with a CT tractor intervention philosophy will result in technical, economic, and environmental advantages in the development of the remaining parts of the field.

References

1. Al-Najim, A., Zahedi, A., Al-Khonaini, T., Al-Sharqawi, A.I., Tardy, P.M.J., Adil, A.R., Nugraha, I., Ramondenc, P. and Al-Hadyani, F.S. (2012). A New Methodology for Stimulation of a High Water Cut Horizontal Oil Well through the Combination of a Smart Chemical System with Real-Time Temperature Sensing: A Case Study of South Umm Gudair Field, PZ Kuwait. Paper presented at the SPE/ICoTA Coiled Tubing and Well Intervention Conference and Exhibition, March 27-28, 2012, The Woodlands, Texas, USA.

2. Arukhe, J., Dhufairi, M., Ghamdi, S., Duthie, L. and Omairen, K. (2012). The First Real Time Logging with Coiled Tubing Tractor in an Extended Reach Horizontal Well with Proof of True Stimulation. Paper presented at the SPE Asia Pacific Oil and Gas Conference and Exhibition, Perth, Australia.

3. Beheiri, F.I., Saudi, M.M., Metwally, S.A., Al-Shammari, N.S., Al-Meshal, F., Noguera, J. and Sierra, L. (2008). Optimization of Coiled Tubing Interventions on Extended Reach Open Hole Completion in a Field in Saudi Arabia. Paper presented at the Abu Dhabi International Petroleum Exhibition and Conference, November 3-6, 2008, Abu Dhabi, U.A.E.

4. Hill, A.D. (1990). Production Logging – Theoretical and Interpretive Elements. SPE Monograph Series, Vol. 14.

5. Meshal, F., Sabut, B., Bawaked, W., Beheiri, F. and Mubairik, A. (2010). Enhanced Coiled Tubing Intervention Practices on Extended Reach Open Hole Completion in a Field in Saudi Arabia. Paper presented at the SPE/DGS Saudi Arabia Section Technical Symposium and Exhibition, al-Khobar, Saudi Arabia.

6. Nasr-El-Din, H.A., Arnaout, I.H., Chesson, J.B. and Cawiezel, K. (2005). Novel Techniques for Improved CT Access and Stimulation in an Extended-Reach Well. Paper presented at the SPE/ICoTA Coiled Tubing Conference and Exhibition, The Woodlands, Texas.

Biographies

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Saleh A. Al-Ghamdi is a Production Engineering Supervisor of the Manifa Production Engineering Division of NAPE&WSD. He joined Saudi Aramco in 2002 as a Production Engineer, working in several fields, including Berri, Shaybah, Safaniya and Marjan, before he joined the Manifa development team in 2008. Saleh received his B.S. degree in Petroleum Engineering from King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia.

Laurie Duthie is a Production Engineer with Saudi Aramco and part of a team focused on the development of the Manifa Field increment. Laurie has more than twenty five years of experience in oil/gas exploration and production operations, management, and petroleum engineering consulting. Started his career in 1986 on offshore installations in the UK North Sea as a Field Engineer in Well Testing and Wireline operations. Laurie has extensive operational experience gained in diverse remote locations onshore and offshore across Africa, Central Asia, Former Soviet Union, Asia Pacific with the last few years in the Middle East region. In 2005, Laurie received his M.S. degree in Petroleum Engineering from the University of New South Wales, Sydney, Australia.

Karam Yateem started his professional career with Saudi Aramco immediately after graduation. Since then, he has completed several assignments in various onshore and offshore field locations. Karam has worked as a Reservoir Engineer, Field Engineer, Testing Engineer and Production Engineer. Author or coauthor of several technical papers, Karam is an active SPE member and currently serves as a committee member of the International Production & Operation committee and is a committee member of the Saudi Arabia Section of SPE. He is also a board member of the Brazil Oil and Gas magazine and USC Alumni Club of Arabia. In 2005, Karam received his B.S. degree in Petroleum Engineering from King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia. In 2010, he received his M.S. degree from the University of Southern California (USC), Los Angeles, CA, in Petroleum Engineering, specializing in Smart Oil Field Technologies and Management. In 2012, he successfully received SPE credentials.

Tamer Elsherif has a petroleum engineering background, graduated from faculty of engineering, Cairo University in June 2006. Since then he have gone through a wide variety of jobs and assignments, starting from production operations engineer at an operating company to ACTive Engineer (fiber optics telemetry enabled coiled tubing) in Schlumberger. In his five years in the industry he has covered a wide spectrum of the production technology domain, namely; Tubulars Design and Analysis; Artificial Lift Design Analysis & Optimization; Single well production modeling and forecasting; Production enhancement; DTS design and analysis; and Dynamic Fluid Analysis.

Danish Ahmed is a Production Technologist in Schlumberger, Saudi Arabia. He began working in Schlumberger-Saudi Arabia in 2007. He worked within different segments in Schlumberger such as with Well Production Services (WPS), Petro Technical Services (PTS) and currently with Well Intervention Services (WIS). While working within above mentioned segments, he gained experience in Production Technology Solutions, Proppant and Acid Fracturing, Matrix Stimulation Engineering, ACTive* Services Platform and Water Shutoff. In 2007, he received his M.S. degree in Petroleum Engineering from Heriot-Watt Institute of Petroleum Engineering, Edinburgh, Scotland.

Wellsite Geoscience Boosts Formation Evaluation While Drilling

By Ryan King, David Tonner, Simon Hughes, Michael Dix; Weatherford.

The Wellsite Geoscience XRD instrument can quantify mineralogy using a small amount of powdered cuttings sample. This technology is identical to that deployed on the NASA rover Curiosity to conduct mineralogical analyses on Mars.

Prior to developing any reservoir, an operator must be able to confidently identify the variation in lithology and reservoir quality, and determine if there are sufficient quantities of hydrocarbons present in the formation.

One of the earliest indications of reservoir quality comes from the mud logging unit, where loggers measure formation gas entrained in the drilling fluid and perform visual descriptions of the cuttings with a low-power microscope. Formation gas is extracted from the recirculated drilling fluid utilizing a mechanical agitation device commonly known as a gas trap. The liberated gas is then introduced to a gas sensor or gas chromatograph (GC) to provide a gas-in-air composition. The quality of the data is limited due to the mixing of the liberated gas with air contained in the gas trap, and because substantial amounts of unmeasured formation gas remains in the mud. This tends to skew the results toward overestimation of methane (C_1) and underestimation of the heavier alkanes (C_2+), as well as providing a less accurate total gas reading from the reservoir interval. For cuttings, visual inspection is qualitative, and details of the lithological description may vary based on the experience of the individual mud logger.

To address these limitations, Weatherford has developed its wellsite geoscience service, which brings a suite of formation evaluation technologies and interpretive techniques from the laboratory to the wellsite. The four primary technologies that make up the service are the GC-TRACER advanced mud gas extraction/detection system, the Source Rock Analyzer (SRA) pyrolysis instrument, an X-ray diffraction (XRD) mineralogy instrument, and the X-ray fluorescence (XRF) elemental analysis instrument. These portable and robust systems provide detailed and objective data on gas composition, organic geochemical parameters (TOC and maturity), mineralogy, and elemental composition/chemostratigraphy. Most importantly, the data is available in near-real time while drilling, where it can actively contribute to improved drilling and completions decisions. Unlike core samples, which have to be specially cut from the formation and sent to a laboratory for analysis, mud gas and cuttings samples are natural by-products of the drilling process, and provide an essentially cost-free source of data (Figure 1). Wellsite geoscience instruments are all surface-based technologies that perform their analyses dependably regardless of difficult or hostile downhole conditions. As such, they can offer a cost-effective, complementary or alternative option for formation evaluation, with zero risk of interfering with drilling operations.

Elemental, mineralogical, and organic geochemical data collected by the instruments can be readily calibrated to baseline measurements from core, and integrated with wire line and LWD log data to provide a more comprehensive formation evaluation while drilling. Taken together, these measurements can be used by the operator to assist with wellbore positioning, formation evaluation, completion design and hydraulic fracturing.

Sharpening the View in Shale Plays

The results produced by the wellsite geoscience instruments are particularly applicable to drilling operations in shale plays, where the ability to optimally extract the hydrocarbon from the source rock has been challenged by incomplete or inaccurate reservoir information. As each new well is drilled, most operators initially choose a simple, geometrical approach to fracturing the entire lateral wellbore section, with little regard to changes in lithology, rock properties or actual hydrocarbon content. This practice of blind, brute-force fracturing produced mixed and unsatisfactory results, as well as a fair degree of confusion as to what constituted best practices for shale completions. This non-uniform production has been highlighted further by a recent industry study that estimated 30-45% of fracture stages contribute less than 1% to overall production.

With variable production often the norm for shale wells, a consensus is emerging that accurate and timely characterization of rock attributes along horizontal wellbores is necessary to improve completion designs, and thus production results. It is critical to identify the optimal combination of hydrocarbon-bearing and brittle lithologies, and develop a production strategy targeting these.

Operators in every shale play share the common goal of finding the so-called “sweet spot” in the reservoir—one or more areas in the formation where the rocks contain the most hydrocarbons and will respond most favorably to fracture stimulations. Key parameters that define the sweet spot for shale reservoirs include: organic richness, thermal maturity, hydrocarbon types, stratigraphic continuity, mineralogy and relative brittleness.

The technologies comprising the wellsite geoscience service can determine most of these parameters from cuttings and gas analysis while the well is being drilled. A description of how this is accomplished is as follows:

Cuttings samples are natural by-products of the drilling process, and provide an essentially cost-free source of data.

Figure 2. Source Rock Analyzer (SRA) instrument used for programmed pyrolysis of cuttings samples at wellsite.

Organic Richness and Thermal Maturity. Total organic carbon (TOC) is widely used to quantify organic richness because it is relatively easy to measure. TOC is directly measured at the wellsite by the SRA (Figure 2) which pyrolizes rock samples – drill cuttings or other crushed rock samples – by progressively heating them to a temperature of 600°C followed by an oxidation phase at 580°C for 15 minutes to remove the non-convertible carbon component of the sample. A flame ionization detector (FID) and two infrared (IR) cells are used to measure and report available hydrocarbon content (S_1), remaining hydrocarbon generation potential (S_2), thermal maturity (T_{max}), and TOC.

Hydrocarbon Types. Advanced mud gas analysis methods have proven useful for real-time fluid characterization to differentiate between liquid hydrocarbons and gas. The mud gas extraction/detection system provides a more accurate approach to mud gas extraction over conventional mud gas traps by using a semi-permeable membrane (Figure 3) as described by Brumboi et al. (2005). The system is

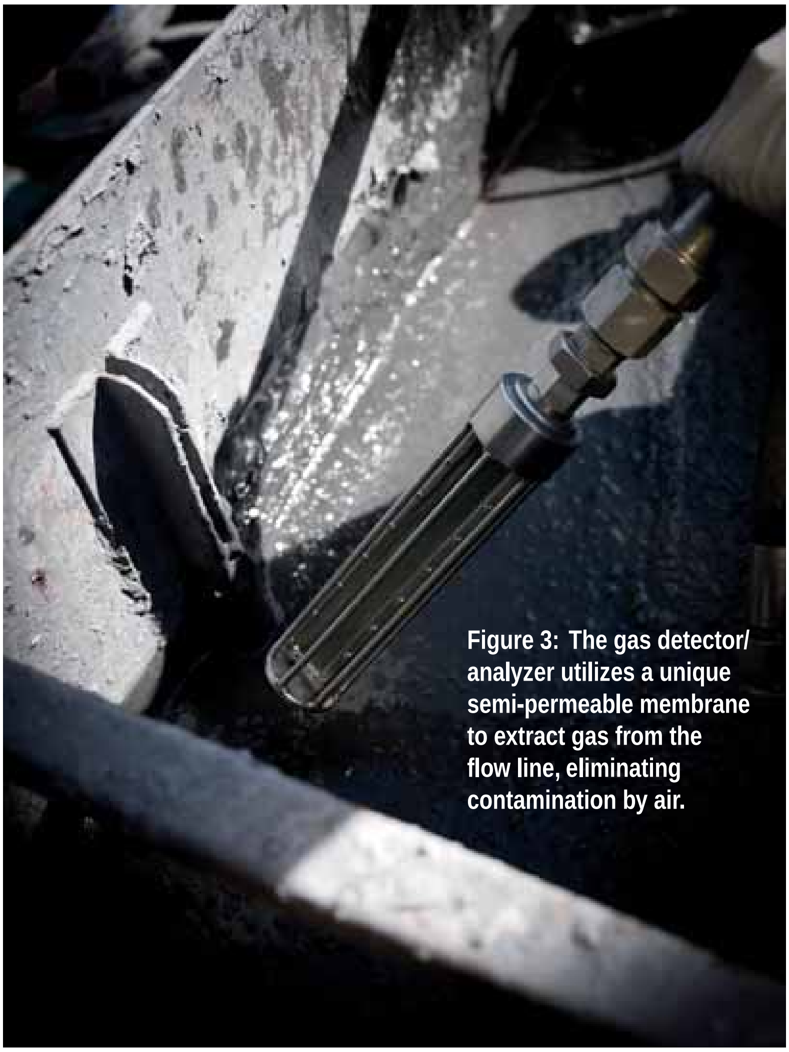

Figure 3: The gas detector/analyzer utilizes a unique semi-permeable membrane to extract gas from the flow line, eliminating contamination by air.

inserted directly into the drilling mud stream, resulting in a gas-in-mud measurement rather than a gas-in-air measurement.

In 55 seconds, the system provides precise compositional analysis of formation gases, including methane (C_1) through octane (C_8), benzene, toluene, ethene, nitrogen, and CO_2. These measurements can be used to infer fluid composition by comparing to gas compositions from IsoTubes/Head Space gas samples, downhole fluid samples analyzed in the laboratory, and the gas composition of produced zones. When membrane-based advanced gas data is combined with the kerogen information and thermal maturity assessment provided by SRA analysis, the most complete hydrocarbon assessment available at wellsite can be obtained.

Stratigraphic Continuity. Shales, siliceous shales, marls and carbonaceous mudstones are the primary reservoir lithologies encountered in shale plays worldwide. Traditional LWD gamma-based and resistivity-based geosteering techniques, when used alone, may struggle to understand stratigraphic position in these lithologies. This is particularly important for recognizing excursions of the wellbore outside the "sweet spot" due to fault throw, dip change, or lateral facies variation. The non-unique signatures provided by only one or two LWD measurements are not sufficient for high-confidence wellbore positioning in many shale plays. This is illustrated in Figure 4, which shows an example of an advanced mud gas log from an Eagle Ford Shale well.

The wellsite geoscience XRF instrument (Figure 5) provides data for up to 31 elements in shaley lithologies, with accuracy and precision, within 30 minutes of cuttings collection. Data includes the 12 major elements (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, S, and Cl) and 19 key trace elements (V, Cr, Co, Ni, Cu, Zn, Ga, As, Rb, Sr, Y, Zr, Nb, Mo, Ba, Hf, Pb, Th, and U). The 31 elements, plus a combination of an additional 100+ elemental ratios, provide the most comprehensive data set for understanding stratigraphic position in near-real time, and for providing active input for geosteering.

It has long been known that certain trace metals (particularly V, Ni, Mo, and U) are concentrated in shales that have been deposited in environments that experienced persistent anoxic and euxinic conditions (see review by Tribovillard et al. 2006). Since these depositional conditions are usually very important for the preservation of high amounts of organic matter, these metals can be closely correlated to TOC values determined by the pyrolysis instrument. This acts as a cross-check for organic richness, as well as providing valuable chemostratigraphic information.

In addition, XRF-measured values of K_2O, Th, and U can be used to calculate spectral and total gamma curves from cuttings (Elemental Spectral Gamma). The correlation of this cuttings-derived gamma to downhole LWD gamma provides quality control for cuttings lag, as well as an independent source of backup data should the LWD gamma sensor fail. Elemental Spectral Gamma data becomes increasingly more important where wireline or LWD logs are more difficult to acquire due to wellbore geometry, elevated temperatures or increased vibration.

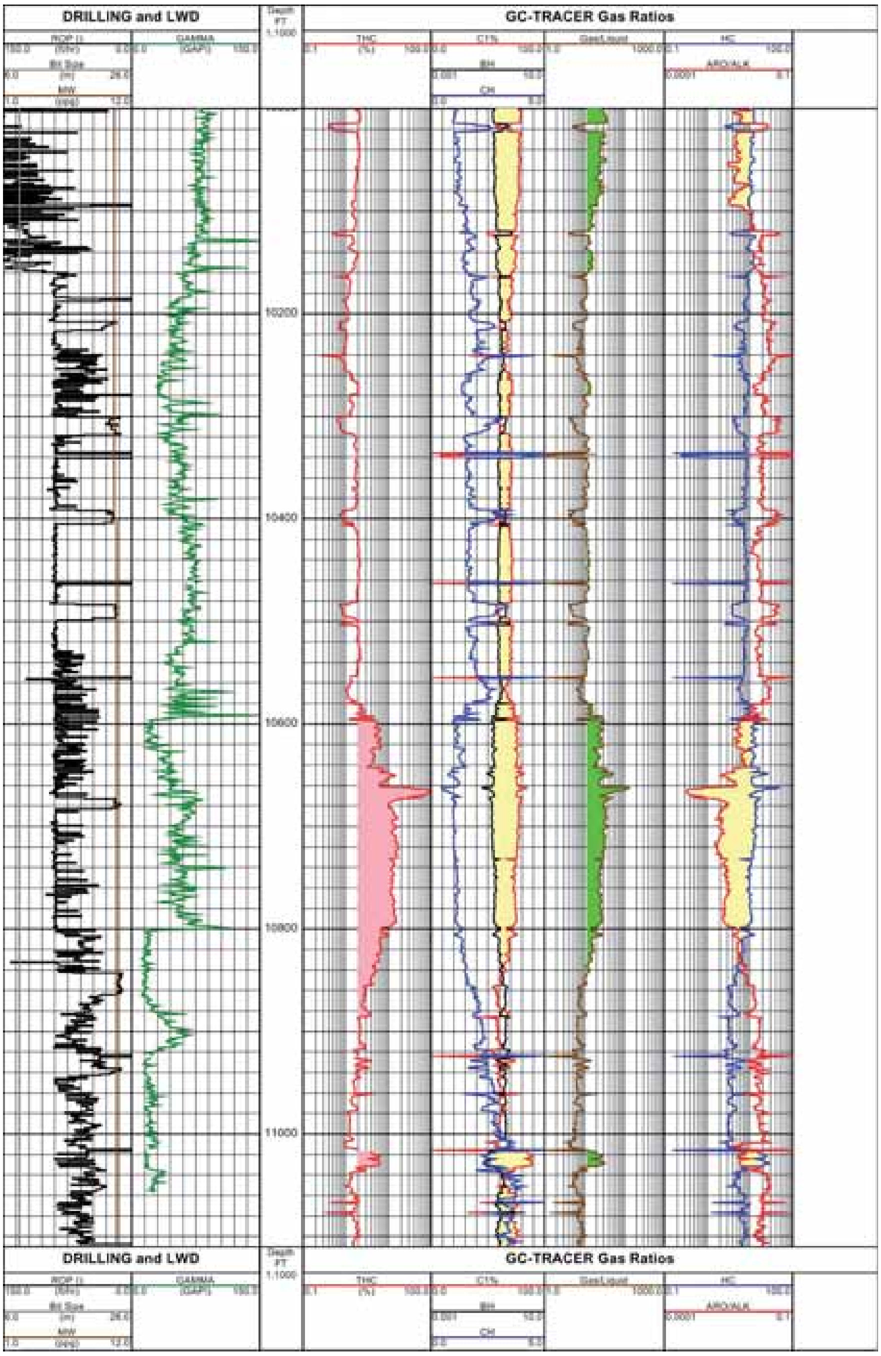

Figure 4: Advanced mud gas data is used to delineate the vertical extent of the reservoir and identify fluid type. Ratios of wetness, balance, character, aromatic/alkanes, and gas-to-liquids (G/L) have been modified to include the full range of gases measured, allowing a more complete fluid interpretation.

XRF elemental chemostratigraphy can be used as a stand-alone stratigraphic technique, but is most effective when combined with wellsite geoscience XRD mineralogy and LWD data.

Mineralogy. Mineralogical composition is the most fundamental attribute of every rock, and controls the properties most relevant for oil and gas production. The wellsite XRD instrument (lead image) can directly measure rock mineralogy from cuttings, generally within 30-45 minutes from cuttings collection at the shaker. The instrument quantifies quartz, opal-CT, plagioclase, K-feldspar, total clay, various carbonate phases, and other important minerals including pyrite, marcasite, apatite, anhydrite and barite. Careful calibration allows precision and accuracy approaching that of laboratory XRD analysis. This mineralogy data is direct input for detailed formation evaluation,

Figure 5: X-ray fluorescence (XRF) instrument is used to perform whole-rock elemental analyses at wellsite. Photo shows sample pellets ready for measurement in the XRF.

and for the calculation of a brittleness index for the shale reservoir. In combination with XRF elemental data, the XRD mineralogy can be refined to infer clay types, low levels of pyrite, apatite, or anhydrite. XRD mineralogy also provides enhanced stratigraphic and diagenetic information, with plagioclase/K-feldspar and quartz/feldspar ratios being particularly important for augmenting XRF elemental data.

The direct measurement of XRD mineralogy and XRF elemental composition from closely spaced cuttings intervals (as close as 5 feet) in vertical pilot holes provide a higher-quality and lower-risk alternative to wire line elemental capture tools.

Brittleness. The relative brittleness of a rock refers to its tendency to fail (fracture) along discrete surfaces when an external force is applied – such as the fluid pressure during hydraulic fracturing – but with little or no internal deformation between the surfaces. The brittleness of zones within shale reservoirs are of critical importance to initiating fracture networks during completions, and for maintaining open fractures that do not suffer from excessive proppant embedment. Because brittleness is directly controlled by mineralogy and the fabric/texture of the mineral components, it can be derived from properly calibrated wellsite XRD and XRF data.

Jarvie et al. (2007) provided a first equation for a brittleness index for the Barnett shale. This equation related higher amounts of quartz (diagenetically redistributed biogenic silica and silt grains) to higher degrees of brittleness, and was a good first approximation for siliceous shales such as the Barnett, Woodford, or Monterey.

The industry soon realized, however, that this initial quartz-based equation is not applicable to all reservoirs. For example, the Haynesville, Eagle Ford, Niobrara and Vaca Muerta formations all have high carbonate contents, and it is this carbonate component rather than quartz that imparts brittleness to the rock. Therefore, it is necessary to create reservoir-specific algorithms to correctly calculate brittleness. These formulas are verified by comparison to fundamental geomechanical data, which is still sparse in most plays but can be estimated by wellsite XRD and XRF data.

Field Deployment Proves Potential

The industry has widely accepted that longer laterals and an increased number of fracture stages increase production. Despite this view, not all wells in a given play produce uniformly even when completed in a similar manner, and in some instances there is significant production variability from wells in close geographic proximity.

In an attempt to maximize productivity, some operators are now depending less on the generic approach to completions and stimulation and are investigating the potential to optimize their production by incorporating more near real-time geological data into their completions designs.

A case study in the Eagle Ford Shale highlights how integrated cuttings and mud gas analysis have been used to identify sweet spots for placement of horizontal

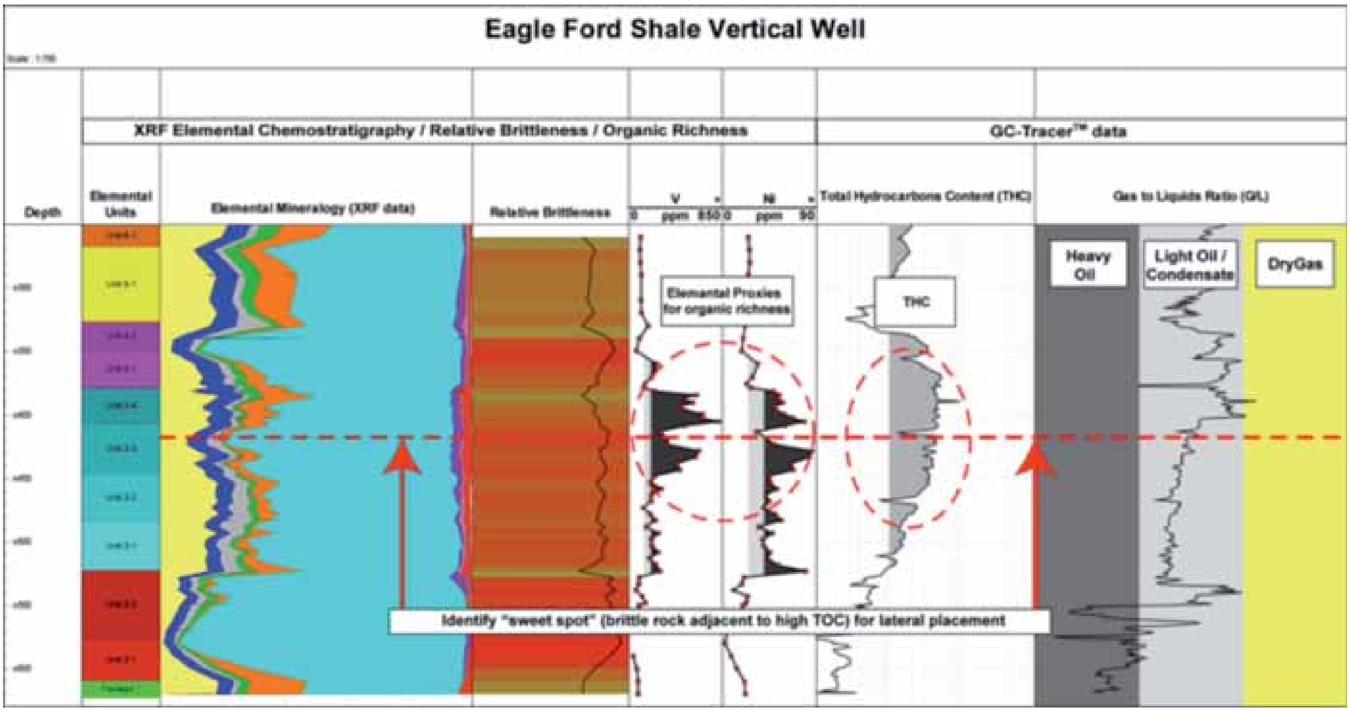

Figure 6. A combination of Wellsite Geoscience data and interpretation, based on XRF and advanced gas analysis, identifies the sweet spot in this Eagle Ford Shale vertical pilot well. Shown on this panel are chemostratigraphic position (track 1), mineralogy (track 2), brittleness (track 3), organic richness by trace metal proxies V and Ni (tracks 4 and 5), total hydrocarbons (track 6), and hydrocarbon type (tracks 7-9).

wellbores in zones of greatest potential (Figure 6). Experience has proven that a combination of known stratigraphic position (chemostratigraphic zone), high brittleness (as estimated from mineralogy and elemental data), proximity to zones of high organic richness (as estimated from trace element proxies V and Ni), and liquid hydrocarbon presence (as interpreted from mud gas data) work together to target the best hydrocarbon zone.

The operator used the wellsite geoscience service successfully on its drilling and completion campaign in the Eagle Ford Shale play. Prior to this development, the company was relying on mud logging, wireline logs and core analysis , the latter of which typically required a six to eight week turn around to receive data.

Since deploying the service in January 2011, the operator has consistently received reservoir data twice daily for every well drilled. The data has allowed the company to make timely course corrections to stay within the target interval, and to confirm TOC content and brittleness of the rock they are drilling (Figure 7).

The service has also helped the completions engineers plan ahead on how best to complete the well and estimate the number and location of their fracture stimulation stages. The strategic fracture-stage placement afforded by the system has allowed the operator to save time and money by developing a truly customized completions strategy for each stage of each well drilled.

On the more than 25 wells drilled using this service, the operator has been able to better optimize its completions spending, and post-stimulation production logs have confirmed the production that was forecasted from the wellsite geoscience analyses. While Weatherford is continuing its work in integrating geoscience, drilling and completions to fully understand the benefits of a more targeted approach to exploiting hydrocarbons in unconventional wells, the operator is planning to expand the use of the service to other shale plays.

Summary

Wellsite geoscience technologies have provided operators with a powerful and cost-effective way of exploiting rich but underappreciated sources of data: mud gas and cuttings. The suite of services is customizable to an individual client's needs as dictated by the challenges they face in understanding the reservoir. This approach has been particularly effective for unconventional resource plays, primarily shales that now account for the majority of wells being drilled in North America. These surface-based measurements

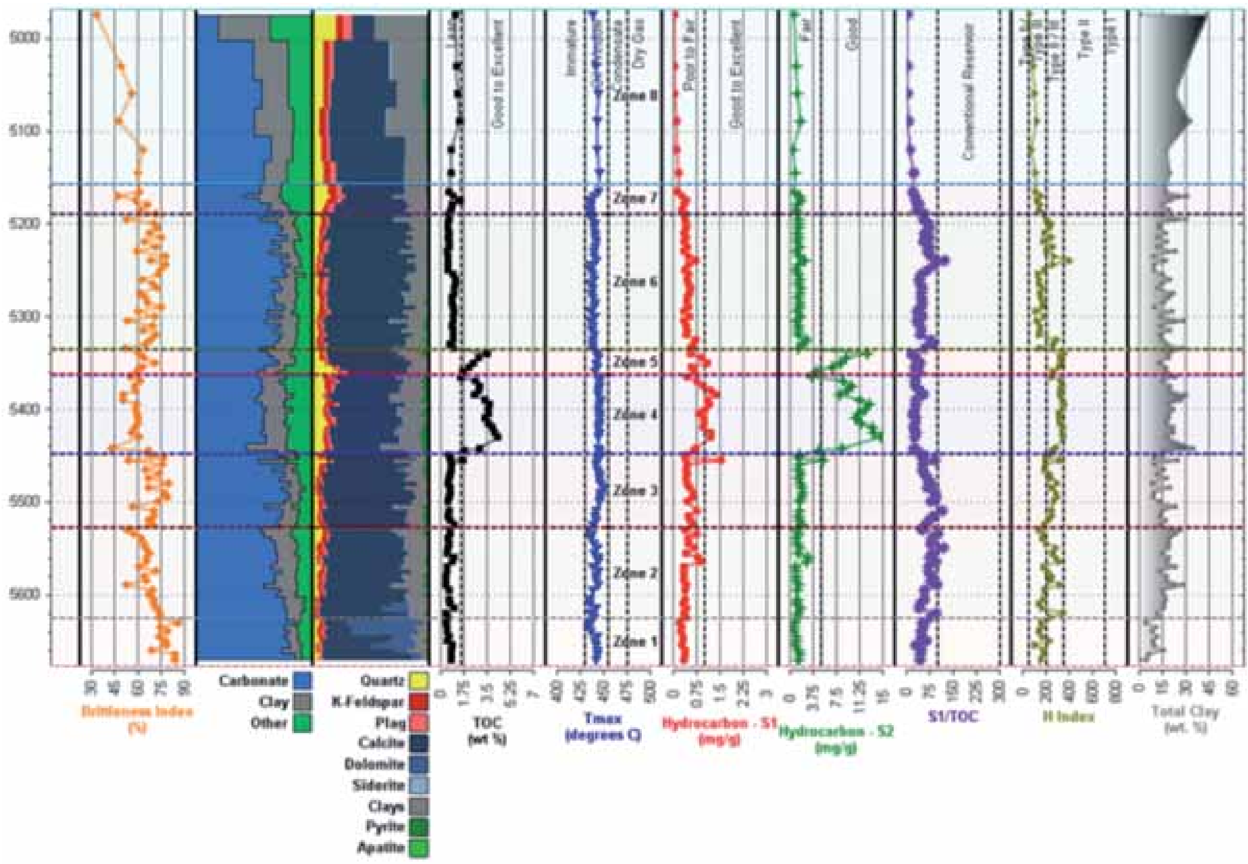

Figure 7. Different applications require different combinations of Wellsite Geoscience data and interpretation. This Well used SRA and XRD to identify the sweet spot in this Eagle Ford Shale vertical pilot well. Shown on this panel are Brittleness Index (track 1), mineralogy (tracks 2 and 3), TOC (track 4), key pyrolysis parameters (tracks 5 through 9) and total clay (track 10). The sweet spot in most unconventional reservoirs is the most brittle interval within or closely associated to the interval with the highest TOC and available hydrocarbon content (Zone 5 in this example).

can all be made without the risks associated with downhole measurements, regardless of temperature, pressure, or vibration in the wellbore, and with little or no impact on drilling operations. Key rock data will be collected from the well even if wellbore conditions deteriorate and logging is not possible. This cuttings data represents an essential link back to laboratory (core) and petrophysical data sets, especially early in a play, when understanding the range of lithologies and fluids present is critical.

The near-real time acquisition of detailed gas composition, organic geochemical parameters, mineralogy, elemental composition, and chemostratigraphic position have allowed a more complete understanding of shale reservoirs while drilling and before well completion. This all increases the ability of operators to better design completions, minimize completions costs, and ultimately optimize production.

References

Brumboiu, A.O, Hawker, D.P., Norquay, D.A., and Law, D., 2005, Advances in chromatographic analysis of hydrocarbon gases in drilling fluids – The application of semipermeable membrane technology to high speed TCD gas chromatography: SPWLA 46th Annual Logging Symposium, Paper 1160685.

Jarvie, D.M., Hill, R.J., Ruble, T.E., and Pollastro, R.M., 2007, Unconventional shale-gas systems: The Mississippian Barnett Shale of north-central Texas as one model for thermogenic shale-gas assessment: American Association of Petroleum Geologists Bulletin, v. 91, p. 475-499.

Tribovillard, N., Algeo, T.J., Lyons, T., and Riboulleau, A., 2006, Trace metals as paleoredox and paleoproductivity proxies: An update: Chemical Geology, v. 232, p. 12-32.

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MEOS 2013

18th Middle East Oil & Gas Show and Conference

Conference: 10 – 13 March

Exhibition: 11 – 13 March

Bahrain International Exhibition and Convention Centre

Conference theme:

Transforming the Energy Future

TRANSFORMING ENERGY FUTURE

Preliminary Conference Programme

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MEOS 2013
18th Middle East Oil & Gas Show and Conference

Welcome Letter from the Conference Chairman

Abdulaziz Al Abdulkarim
MEOS 2013 Conference Chairman
SAUDI ARAMCO

Dear Colleagues,

As Chairman of the 18th MEOS 2013 Conference I am delighted to extend an invitation to you for this renowned event. The Middle East Oil & Gas Show and Conference (MEOS) will be held 10-13 March 2013, at the Bahrain International Exhibition and Convention Centre in the Kingdom of Bahrain.

The theme for MEOS 2013, "Transforming the Energy Future", will be the foundation for the multidisciplinary technical programme which includes over 140 presentations during 36 technical sessions, as well as over 50 poster presentations. The agenda will also comprise of a high level executive plenary session, with key speakers already confirmed, and five panel sessions discussing pertinent topics relevant to the industry. The conference will boast a number of additional features which you can find highlighted in this preliminary programme.

Running parallel to the conference, the exhibition is the utmost established of its kind in the region. MEOS 2013 will host over 300 exhibitors from 30 countries including NOCs, IOCs, and major operating companies showcasing oil and gas products and services.

Delegates and visitors who attend MEOS will find it to be a valuable and skill-developing experience that will both broaden and enrich their knowledge. Providing unrivalled business and networking opportunities, MEOS continues to be a leading event for those involved in all sectors of the oil and gas industry.

Sincerely,

Abdulaziz Al Abdulkarim
MEOS 2013 Conference Chairman
SAUDI ARAMCO

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Opening Ceremony & Executive Plenary Session

SUNDAY, 10 MARCH 2013

1630–1730 OPENING CEREMONY — Room 1 & 2

OFFICIAL OPENING BY

H.E. Shaikh Ahmed bin Mohammed Al Khalifa
Minister in Charge of Oil & Gas Affairs, Bahrain
Chairman of the Board of Directors
NATIONAL OIL & GAS AUTHORITY

ADDRESS BY

Abdulaziz Al Abdulkarim
MEOS 2013 Conference Chairman
SAUDI ARAMCO

ADDRESS BY

Egbert Imomoh
2013 SPE President

2013 MEOS Opening Ceremony will be attended by various Regional Oil Ministers from the GCC States including H.E. Dr. Mohammed Bin Hamad Al Rumhy, Minister of Oil and Gas, Sultanate of Oman.

1730–1930 EXECUTIVE PLENARY SESSION — Room 1 & 2

Transforming the Energy Future

SPEAKERS

Amin H. Nasser
Senior Vice President Upstream
SAUDI ARAMCO

James Johnson
President, Europe, Eurasia and Middle East Exploration and Production
CHEVRON

Martin Craighead
President and CEO
BAKER HUGHES

SPEAKERS

Paal Kibsgaard
CEO
SCHLUMBERGER

Sami F. Al-Rushaid
Chairman and Managing Director
KUWAIT OIL COMPANY

Sara Ortwein
President
EXXONMOBIL
UPSTREAM RESEARCH

Energy drives our future, but we drive the future of energy!

The ability to adequately source and efficiently use energy is fundamental to human development. However, the challenges of providing energy are steadily increasing. In particular, the effort required to extract fossil fuels expands as more complex and less accessible reservoirs need to be developed.

The industry is meeting the challenge of sourcing by improving/enhancing recovery from conventional resources and intensifying exploration activities in more complex reservoirs, remote areas and harsh environment, as well as expanding into unconventional hydrocarbons.

With regard to the challenge of efficiency, the industry is transforming and introducing new and advanced applications of processes, technologies and business models, all driven by tapping into the ingenuity, creativity and skills of talented people.

The executive plenary session will address options and ideas required for transforming our industry to meet future energy needs effectively and efficiently, with a view to exploring and challenging the perceived limits.

1930 CONFERENCE OPENING DINNER

Ritz Carlton Hotel

MONDAY, 11 MARCH 2013

1045–1245 PANEL SESSION 1 Room 1

The Gas Challenge

PANELISTS

Ali Al Ghamdi
Chief Petroleum Engineer
SAUDI ARAMCO

Aaron Gatt
Characterisation Group President
SCHLUMBERGER

Menahi Al Anzi
Deputy MD of Gas and Planning
KUWAIT OIL COMPANY

Mounir Bouaziz
Vice President Commercial for Middle East & North Africa
SHELL

Peter Clarke
Business Planning & Analysis Manager
EXXONMOBIL

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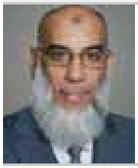


Mohammad A. Hussain
President and CEO
EQUATE

Abdulrahman Al Jarri
Manager, Production & Facilities Development Department
SAUDI ARAMCO

Over the past few years gas has sailed up as a major source of growth in energy supply, through increased development of known resources, discovery of new conventional fields and exploitation of unconventional resources. Gas is being hailed as the product of choice because of its apparent abundance, its low environmental impact and its safety record, particularly when seen as an alternative to nuclear energy in the wake of the Fukishima incident. However, this resurgence carries with it new challenges, particularly in the Middle East. The Middle East and North Africa (MENA) as a region accounts for around 40% of the world's proven gas reserves, but only 10% of current production. These challenges will have special focus in the MEOS 2013 conference.

Among the regional issues that could be addressed are the rising demand for energy in general, gas as a cheap source of fuel for domestic industrialisation, the limited current cross-border trade in gas, the options for new pipelines and LNG transport, and the need to maintain oil as an export commodity for maintenance of budget balances.

Gas markets in the area could tighten significantly if these issues are not addressed, but the possible presence of large unconventional gas potential could also have major ramifications following the success of shale gas in the USA and the plethora of potential other energy sources (e.g. coal and renewables).

However, both piped gas and LNG provide opportunities for trade within the region and further afield. In this area pricing policies for gas will have a major impact on option development, despite the pressure of US shale gas, Asian oil-indexation and European hybrid spot-term pricing. Throw in the shift in operational tactics by pirates in the Indian Ocean, using larger vessels to extend their reach to all major shipping lanes in the area, and the set of challenges to gas in the region should provide the basis for significant discussion in MEOS 2013.

MONDAY, 11 MARCH 2013

1045–1245 PANEL SESSION 2 Room 2

Talent Development and Knowledge Sharing

PANELISTS

Louise M. McKenzie
Reservoir Engineering Manager
EXXONMOBIL

Luca Filipetta
Country HR Manager Saudi Arabia & Bahrain
WEATHERFORD

Nasser A. Al-Nafisee
General Manager, Training and Development
SAUDI ARAMCO

Shabir Al Lawatiya
Talent Development Manager
PETROLEUM DEVELOPMENT OMAN

MODERATORS

Khaled Nouh
President Middle East
BAKER HUGHES

Badria Ali Abdul Raheem
Manager Fields Development (S&EK)
KUWAIT OIL COMPANY

Talent development and knowledge sharing are key elements of any organisational strategy aiming to enhance and articulate workforce competencies. In the oil and gas industry, these aspects are particularly critical to ensure the availability of a skilled workforce, able to meet the accelerating pace of world energy demand. Due to changes in the demographics within the energy industry today, there is an immediate need to bridge the gap between the experienced and newly hired workforce. This can be achieved through integrating knowledge sharing with talent development. The retiring of technologists has led to a wider skill gap in key critical competencies that are required today much more than in the past due to the increasing complexities of future discoveries and oil and gas prospects. Ways in which we as industry leaders should fill this growing gap are:

- Dynamic measurement of industry changes
- Development & retention of key talent
- Knowledge sharing

As new reservoirs are discovered and new complex production methodologies are developed, the need is growing to share learning, best practices and knowledge to allow the industry to capitalise on opportunities quickly. An example of this is the accelerated unconventional shale oil and gas development in North America and the potential of developing similar unconventional reservoirs throughout the world. In order for organisations to compete and meet the changing environment, the utilisation of innovative knowledge sharing tools and processes to build a strong talent foundation is required. Collaborative knowledge sharing leverages the organisation to accelerate the development of their workforce with the use of both new and old communication methodologies.

The speakers will address the persistent unsolved diatribes in sharing best practices and training, which have puzzled not only the experts in talent development, but also have baffled managers who confront every day training decisions: Are formal courses still an effective strategy? Is self-development reliable and certifiable? How do we effectively detect and develop high-flyers? How can we transform experts into mentors? What elements of training are motivators for a healthy professional journey? Are soft skills really a minor subject for a successful career? How the organisation allows sharing knowledge and best practices?

The future prosperity and success of our industry will depend on our ability to develop talent from a technical and leadership perspective in anticipation of the future needs of the industry. Organisations need to align their strategies, practices and processes in such a way that collaborative knowledge sharing becomes an integral part of the development of their talents and overcome the challenges of the changing business landscape.

TUESDAY, 12 MARCH 2013

1045–1245 PANEL SESSION 3 Room 1

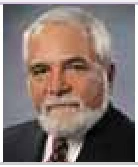
Technologies Required to Unlock Unconventional Resources

PANELISTS

Nick Gee
Senior Vice President, Formation Evaluation and Well Construction
WEATHERFORD

Richard Newhart
Team Lead-Subsurface & New Ventures
ENCANA USA

Samer S. Al Ashgar
Manager, EXPEC Advanced Research Center
SAUDI ARAMCO



Turgay Ertekin
Professor of Petroleum and Natural Gas Engineering
PENN STATE UNIVERSITY

Usman Ahmed
Vice President for Unconventional and Chief Reservoir Engineer
BAKER HUGHES

MODERATORS

Abdulaziz Al-Kaabi
Chief Technologist
SAUDI ARAMCO

Mohammed Badri
Managing Director – Research
SCHLUMBERGER

Technology has played an important role in the development of hydrocarbon resources in the past. In many cases it has made unconventional resources an economically viable source of energy. Recent examples of such technologies include horizontal and multi-lateral wells, 4D seismic and advanced fracturing techniques. A game-changing area of hydrocarbon resource development that optimises the application of technology is unconventional gas including shale gas. Single-handedly, unconventional gas has altered the energy landscape in the US and its potential is being investigated in petroleum basins throughout the world. However, the lessons learned in the US in the development of this unconventional resource are not necessarily directly applicable or 'transferable' to other parts of the world. Economics and technology will both play an important role in its application and deployment worldwide.

This panel will provide a holistic picture of unlocking this resource and address specifically:

- Basics including what constitutes unconventional gas, how to determine its potential in a given basin or region and estimate reserves
- Economics including the impact of regional gas prices on its development, the economies of scale in terms of project size and estimating the cost of production
- Technical including reservoir characterisation, predicting the sweet spots for drilling, advanced fracturing technologies, determination of petrophysical properties, geomechanics, reservoir modeling, estimating the recovery factor and optimum production strategies
- R&D including optimum investments for research, role of university and industry and what are the most influential technologies for the exploitation of unconventional gas
- Environment concerns related to its development

The topics that will be covered by the panel include opportunities, technological challenges and innovations, lessons learned and adoption of best practices to make this unconventional resource a viable reality.

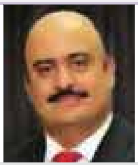
TUESDAY, 12 MARCH 2013

1045–1245 PANEL SESSION 4 Room 2

Greener Petroleum – Collaboration for Sustainability

PANELISTS

Dorine Bosman
Vice President Social Performance
SHELL



Ebrahim Talib
Deputy Chief Executive
BAPCO

Gaurav Agrawal
Director of Enterprise Research
BAKER HUGHES

Greg Powers
Technology Senior Vice President
HALLIBURTON

MODERATORS

Frank Kemnetz
Vice President
EXXONMOBIL UPSTREAM VENTURES (MIDDLE EAST)

Billy Dean Gibson
Vice-President Marketing
SCHLUMBERGER (MIDDLE EAST)

Energy, economy, environment: three of the most important global issues facing governments, industries and consumers today and they are all interdependent. Energy is essential to fuel economic growth and the availability and cost of energy affects economic development. Every form of energy production also has an impact on the environment, with climate change due to greenhouse gas emissions being one of the most widely debated environmental issues.

Because energy, economy and the environment are interdependent, sustainable solutions will be those that foster continued economic growth with more efficient energy use and reduced environmental impact. Energy producers and consumers alike have important roles in achieving this objective. Cooperation and collaboration are key in making wise decisions about how we produce and consume energy in the future.

While significant progress has been made in recent years, the oil and gas industry still faces significant challenges in continuing to supply the world's growing needs for affordable, reliable energy while further mitigating the environmental impact. This panel seeks to bring together experts for a constructive dialogue on the future of the energy industry, with particular focus on collaboration to achieve a more sustainable energy future.

WEDNESDAY, 13 MARCH 2013

1045–1245 PANEL SESSION 5 Room 1

Developing Local Content

PANELISTS

Basav Ray Chaudhuri
Local Content Manager
SCHLUMBERGER

Mohammed Abduldayem
Country Manager for Saudi Arabia
WEATHERFORD

Simbi Wabote
Global Manager for Local Content Development
SHELL

Sultan Al-Hajji
Vice President Institutional Development
TOTAL

MODERATORS

Husam Jahadhmi
Contracts and Procurement Manager
PETROLEUM DEVELOPMENT OMAN

Alasdair Shiach
Vice President and Managing Director
BAKER HUGHES

Historically the energy sector has been the major contributor to the region's economic well being, not only from direct investment and job creation but also from the industries and services that develop to support the energy sector. As populations continue to grow there is a pressing need to increase the rate of job creation over and above what the energy sector has traditionally achieved.

Developing local content is essential to encourage national and regional development through the growth of local manufacturing and service industry and human capital.

Education, training, experience and business development in the manufacturing and service sectors are essential to create employment and feed into growth of regional economies. However, developing local content is not without its challenges as both established businesses and entrepreneurs reconcile local content desires and responsibilities with constraints related to capital, quality, service delivery, technology, supply chain and human capital.

The panel will present and debate on how developing and sustaining local content can most effectively be achieved at a pace that meets the needs of the region.

0800–1000 INDUSTRY BREAKFAST SESSION Hall 2

SPONSORED BY

Speaker Biography

H.E. Abdullatif A. Al-Othman was appointed as SAGIA Governor on 18 May 2012.

Al-Othman is a 1979 graduate of KFUPM with a B.A. in civil engineering. In addition, he earned his master's degree in business administration from the Massachusetts Institute of Technology (MIT) as a Sloan Fellow in 1998.

Al-Othman began his career with Saudi Aramco in March 1981 as an engineer in Engineering and Project Management. Throughout the 1980s, Al-Othman worked as an engineer on the Gas Gathering Project, Phase II, the Ras Tanura Refinery Modernisation Project, the Qasim Refinery Project, the Southwest Refinery Project, and the Ras Tanura and Terminal Projects. In 1990, he was promoted to senior project engineer in the Marjan Completion Division and worked in project management until 1994. From 1994 to 1999, Al-Othman served in staff support functions in Engineering and Project Management, including the Total Quality Management Program. He also was manager of Resource Planning and acting manager of Southern Area Projects. From February 1999 to February 2001, Al-Othman was assigned to Contract Review and Cost Compliance in Finance. He also held the positions of manager of Business Analysis and manager of Long Range Planning in the Corporate Planning function. In February 2001, Al-Othman moved to Crude Oil Sales and Marketing as manager. In June 2001, he was named executive director of Saudi Aramco Affairs and was appointed vice president of Saudi Aramco Affairs in September 2001. In 2003, Al-Othman was named vice president of Finance then was later named senior vice president of Finance, in May 2005.

Al-Othman served as president for the Project Management Institute (PMI) Arabian Gulf Chapter and was a member of the International Association of Energy Economics.

SPEAKER
H.E. Abdullatif A. Al-Othman
Governor and Chairman of the Board of Directors
SAUDI ARABIAN GENERAL INVESTMENT AUTHORITY (SAGIA)

Financing the Change

Some analysts foresee that the oil industry will spend around 15 trillion dollars during the coming 10 years to meet the expected future oil and gas demand. They further estimate that oil and gas reserve additions from recovery enhancement will most likely supersede the additions from grass root exploration. The planned breakfast session shall address in focus the following subjects:

- What are the main changes that we expect to see during the coming decade?
- Who will develop the strategies and drive their execution?
- How best can these changes be managed and financed?

What?

- Increasing focus on enhancing recovery from oil and gas producing assets
- Increasing focus on hydrocarbon production from tight, deep and unconventional reservoirs
- Dealing with business uncertainties, especially those linked to future oil and gas demand and pricing
- Increasing environmental awareness and thus environmental control and constraints
- Cost and risk attached to the incremental development barrels will be progressively higher than current levels
- New financing models need to be developed to encourage the participation of the public
- Technological advancement and innovative thinking will be the driving force for achieving all above

Who?

- Host governments to either directly finance or make the necessary changes to enable and encourage investors' participation
- International and independent oil companies will be the main drivers for implementing these inevitable changes
- Service companies will be required to align their research and development functions to the requirements of the end users. They may also find merits in forming alliances with oil companies to shoulder some risk for bigger rewards
- Investment institutions and banks will need to digest and address the future financing requirements of the oil and gas industry. They should develop some innovative financial solutions to meet the enormous funding requirements
- The general public shall be encouraged to participate in financing at least some of the future energy projects

How?

- The relationship between any two or more parties of the above stakeholders will mandate introducing innovative business solutions for managing risks, ensuring growth and sustaining success
- Therefore, a dedicated effort must be made to first understand the strengths and weaknesses of the currently used models such as EPSAs, DPSAs, services and buy-back agreements etc. to assess their capability for meeting the business challenges of the anticipated transformation
- Design and develop additional business solutions to encourage collaboration between the various parties and to build the momentum for financing and managing the foreseen changes

Admissions to the Industry Breakfast Session is limited to Full Conference Delegates and avaliable on a first-come-first-serve basis. Deadline to sign up for the Industry Breakfast Session is 28 February 2013 after which registration to this session will be closed.

Further information on registrations will be sent to conference delegates by early February 2013.

Technical Programme

Technical Discipline Key:

EXPLORATION & APPRAISAL	DRILLING & COMPLETIONS	RESERVOIR ENGINEERING	PRODUCTION & FACILITIES	HSSE

MONDAY, 11 MARCH 2013

SESSION 1 | **ROOM 1** | 0800–1000

UNCONVENTIONAL RESOURCES – IDENTIFICATION AND EVALUATION

SESSION CHAIRPERSONS:
François-Michel Colomar, *Beicip Franlab IFP Middle-East Consulting*
Adrian Pearce, *Total E&P*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164345	**Marcellus Shale Gas Asset Optimisation Driven by Technology Integration** P.S. Kaufman, G. Forrest, K. Atwood, K. Walker, K. Wutherich, D. Delozier, A. Perakis, S. Borchardt, K. Hauser, Schlumberger
0830	164254	**Pore Systems in Shale-Gas and Shale-Liquids Plays** M. Rudnicki, Q.R. Passey, J. Kalbas, D.N. Awwiller, ExxonMobil Corporation
0900	164364	**Unconventional Natural Gas Potential in Saudi Arabia** A. Sahin, King Fahd University of Petroleum and Minerals
0930	164468	**A New Gas Storage Model Including Capillary Condensation for Unconventional Shale Gas Reservoirs** D.T. Georgi, Baker Hughes

Alternates/Posters

	164360	**Understanding Reservoir Properties Through High-Definition Microresistivity Images in Horizontal Shale Oil Wells Drilled with OBM in China** H. Huijun, Schlumberger
	164290	**Quantification of Rock Porosity Changes before and after Freezing** K. Ling, J. He, Z. Zeng, University of North Dakota
	164406	**Application of Bacterial Mat for Optimised Gas Hydrate Recovery at the Sea Surface** A. Dubey, A. Saxena, University of Petroleum and Energy Studies – India
	164448	**Modern Practices in Estimation of Explored Petroleum Resources in Sedimentary Basins Including CBM Fields** K.C. Dani, V.K. Baskaran, Mansarovar Energy Colombia Limited; S. Varyani, K. Kumar, University of Petroleum and Energy Studies

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 2 | ROOM 2 | 0800–1000

ADVANCED COMPLETION SYSTEMS

SESSION CHAIRPERSONS:
***Steve Dyer,** Schlumberger and **Abdulla Al-Rabah**, Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164416	**Successful Expandable-Liner Hanger Installation in one of the World's Longest Extended Reach Wells** M. Hood, T. McCright, M. Aly (Shafy), D. Giusti, Halliburton
0830	164147	**New Generation Intelligent Completion System Integrates Down-Hole Control with Monitoring in Multi-Lateral Wells** K.S. Al-Mohanna, S. Jacob, L. Ma, Saudi Aramco; M. Shafiq, Schlumberger
0900	164373	**Design and Development Considerations for 9-5/8-in. 10,000-psi, Large-Bore Subsurface Safety Valves** M. Davidson, Baker Hughes
0930	164348	**Smart Well with Autonomous Inflow Control Valve Technology** V. Mathiesen, B. Werswick, H. Aakre, InflowControl

Alternates/Posters

	PAPER NO	TITLE AND AUTHORS
	164367	**Liner Hangers Technology Advancement and Challenges** A.O. Mohamed, A.A. Al-Zuraigi, Baker Hughes
	164144	**Helical and Hybrid Passive Inflow Control Devices Characterisation Through Two-Phase Flow Loop Test** B.O. Lee, M. Alrabeh, Saudi Aramco; R. Vicario, P. Gavioli, G.A. Garcia, Baker Hughes
	164374	**Practical Aspects of Multistage Fracturing: Challenges, Solutions, and Performance** M.A. Alghazal, S.M. Al-Driweesh, Saudi Aramco; S. Wilson, Schlumberger; B.B. Johnston, Packers Plus Energy Services
	164450	**Lessons Learnt from Perforated Liner with Swell Packer Stuck in N. Azadegan Field** L. Rong, L. Wanjing, L. Zhiping, China University Geosciences, Y. Chengjin, Y. Kaicai, CNPCI (Iran); L. Yansheng, Sinopec International

SESSION 3 | ROOM 3 | 0800–1000

RESERVOIR MODELLING 1

SESSION CHAIRPERSONS:
***Adel Hussain Malallah,** Kuwait University and **Nawzad Khurshid**, Occidental Oil & Gas*

TIME	PAPER NO	TITLE AND AUTHORS
0800		 KEYNOTE SPEAKER Akhil Datta-Gupta **Regents Professor** TEXAS A&M UNIVERSITY
0825	164187	**Answer the Challenges of Upscaling a 900 Million-Cell Static Model to Dynamic Models – Greater Burgan Field, Kuwait** E.D. Ma, F.A. Abdulla, R.A. Al-Houti, L. Dashti, Kuwait Oil Company; Y. Wang, S.A. Ryzhov, F. Bouchet, Schlumberger
0850	164279	**Improvement in Reservoir Understanding Through Assisted History-Matching: The Case of a Pan-Reservoir Diagenesis Flow Baffle in a Polymer Flood Candidate** G. Riethmuller, Z.A. Mohamad, G. Stapel, S. Nijman, A.H. Abri, S. Mahruqi, W. Subhi, R. Mehdi, Petroleum Development Oman
0915	164199	**Numerical Simulation of Polymer Augmented Waterflooding in Heterogeneous Reservoirs** T. Teklu, H. Kazemi, R. Graves, Colorado School of Mines; A. AlSumaiti, The Petroleum Institute
0940	164142	**Uncertainty Quantification Workflow for Mature Oilfields: Combining Experimental Design Techniques and Different Response Surface Models** S. Jawwad Ahmed, R. Recham, ADNOC; A. Nozari, R. Schulze-riegert, S.U. Bughio, R. Bin Salem, SPT Group

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 3 | ROOM 3 | 0800–1000

RESERVOIR MODELLING 1

SESSION CHAIRPERSONS: ***Adel Hussain Malallah**, Kuwait University and **Nawzad Khurshid**, Occidental Oil & Gas*

TIME	PAPER NO	TITLE AND AUTHORS
Alternates/Posters		
	164312	**Reservoir Connectivity Evaluation and Upscaled Model Screening Using Streamline Simulation** J.P. Fanjul, Repsol SA
	164429	**Designing a High Performance Computational Platform for Simulation of Giant Reservoir Models** E.M. Hayder, M. Baddourah, B. Harbi, F. Abouheit, A. Darrab, O. Hajjar, U. Nahdi, A. Zawawi, K. Zamil, Saudi Aramco
	164420	**Petrel Workflow for Adjusting Geomodel Properties for Simulation** D. Hoffman, M. Yousif, Tatweer Petroleum

SESSION 4 | ROOM 4 | 0800–1000

FIELD DEVELOPMENT OPTIMISATION

SESSION CHAIRPERSONS: ***Badria Ali AbdulRaheem**, Kuwait Oil Company and **Roxy Thawer**, AAR Energy*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164141	**The Effect of Rock Properties on Remaining Oil Saturation in a Heterogeneous Carbonate Reservoir: Case Study, Giant Oilfield, Onshore Abu Dhabi** S. Serag El Din, M.Z. Kalam, ADCO, M. Dernaika, Ingrain
0830	164461	**Illuminating the Reservoir: Magnetic Nanomappers** A.A. Al-Shehri, Saudi Aramco
0900	164216	**Implementing Water Flood in the Greater Burgan Field, Kuwait: Improved Development Planning Through Pilot Testing and Field Appraisal Activities** A.A. Ameen, B.A. Abrahim, M. Al-Naqi, M.N. Al-Qattan, H.H. Al-Hashash, S. Rajan, N. Al-Enizi, S. Madhavan, A. Al-Qattan, Kuwait Oil Company; H. Kreutz, D. Brooks, AAR Energy
0930	164422	**Optimal Development Strategies: Use of Optimisation Combined with Fast Semi-Analytical and Numerical Simulators** A. Alvi, R. Banerjee, N. Bolanos, P.G. Tilke, Schlumberger
Alternates/Posters		
	164327	**Extending Marginal Field Life Through implementation of Hydraulic Fracturing** H.S. Al-Busaidi, Petroleum Development Oman
	164223	**A Field Trial to Assess Asphaltene Related Production Impairment – Marrat Reservoir, Magwa Field, Kuwait** A. Al-Qatan, V.S. Chimmalgi, H.H. Dashti, R. Haryono, F.A. Abdulla, J. Al-Humoud, Kuwait Oil Company; D.J. Bond, D.J. Bond and Associates Limited
	164344	**Rejuvenating a Mature Transition Zone Carbonate Waterflood Through Subsurface – Surface Integration: The Value of Combining Improved Subsurface Understanding While Managing Aging Facilities (Shuaiba, Sultanate of Oman)** M. van Koolwijk, A. Ghufaili, G.M. Warrlich, P.M. Goossens, M. Ogawa, A. Adhoobi, M.S. Al-Hajri, H. Armstrong, Petroleum Development Oman

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 5 | ROOM 5 | 0800–1000
PRODUCTION MANAGEMENT AND OPERATIONS 1

SESSION CHAIRPERSONS:
Donald Yeager, *ExxonMobil and* ***Mohammad Al-Jadi,*** *Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164237	**Record Coiled Tubing Aided Reach and First Real-Time Logging with Tractor in Extended Reach Well** J.O. Arukhe, M. Dhufairi, S. Ghamdi, L. Duthie, K. Omairen, Saudi Aramco
0830	164170	**Production Network Modelling Challenges in a Giant Carbonate Reservoir** S. Al-Sayari, S. Al-Nuimi, S. Misra, ADCO
0900	164301	**Building a Large Scale Sustainable Integrated Asset Model for Greater Burgan** F. Ali, J. Al-Hamoud, D.S. Almater, M. Al-Naqi, R.M. Al-Wazzan, Kuwait Oil Company; R. Thawer, J. Joslin, AAR Energy
0930	164467	**Inflow Profiling in Challenging Complex Deep Gas Environment** F.O. Osifo, Saudi Aramco; M.A. Bawazir, Z. Zaouali, M. Zeybek, Schlumberger

Alternates/Posters

	164264	**Challenges in Scale Inhibitor Treatments in Multilateral Complex Wells – A Production Engineering Perspective with Case Study** K. Baruah, N.M. Al-Otaibi, F.M. Al-Subaie, Saudi Aramco
	164440	**New Numerical and Analytical Models to Quantify the Near-Wellbore Damage due to Sulfur Deposition in Sour Gas Reservoirs** M.A. Mahmoud, King Fahd University of Petroleum and Minerals
	164297	**Trial of Multiphase Flow Meters on Remote Well Head Towers** R.V. Challa, ZADCO

SESSION 6 | ROOM 6 | 0800–1000
HSE

SESSION CHAIRPERSONS:
Mohammed Abdulgader, *Saudi Aramco and* ***Jane Alcock,*** *Shell*

TIME	PAPER NO	TITLE AND AUTHORS
0800		 KEYNOTE SPEAKER Roland L. Moreau URC SSH&E Manager EXXONMOBIL UPSTREAM RESEARCH COMPANY
0825	164430	**Pursuing HSE Through Operational Excellence in Saudi Arabian Fields** A.S. Al-Kuait, Saudi Aramco
0850	164455	**Safety Management System Excellence Journey** K. Al-Humaini, Saudi Aramco
0915	164197	**Creating a Culture of Safety and Reliability in the Offshore World** T. Matthews, BST
0940	164407	**Lightning on the Rise in Unsuspecting Places: The Storage Tank Protection Imperative** N. Mascarenas, Lightning Eliminators and Consultants Incorporated; M. Nambiar, Consilium Middle East

Alternates/Posters

	164401	**Initiatives to Improve Well Intervention Safety** K.I. Omairen, A. Kuait, M.A. Zubail, A. Bukhamseen, Saudi Aramco
	164435	**Air Quality Control Initiatives at Uthmaniyah Gas Plant** A. Al-Balawi, Saudi Aramco

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 7 | ROOM 1 | 1400-1600

DRILLING AND OPERATIONS OPTIMISATION

SESSION CHAIRPERSONS:
Mohammed Badri, *Schlumberger and* ***Michael Bittar,*** *Halliburton*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164365	**Filling the Experience Gap in the Drilling Optimisation Continuous Improvement Cycle Through a Self-Learning Expert System** C.H. Kirby, A.G. Sadlier, C. Wood, Baker Hughes; M.L. Vinther, Verdande Technology AS
1430	164204	**Field Specific KPI: An Innovative Approach to Drilling Performance Management** A.E. Weekse, M.A. Muqeem, A.A. Al-Hajji, K.K. Abouelnaaj, A.A. Al-Mumen, Saudi Aramco
1500	164215	**A New Standard in Wireline Coring: Recovering Large Diameter Wireline Core Through Standard Drill Pipe and Custom Large Bore Jar** T.M. Farese, H. Ahmed, National Oilwell Varco; I.A. Adebiyi, Saudi Aramco
1530	164163	**Outstanding Well Construction Industrialisation Bringing Tunu Field Production To New Perspectives** S. Oumer, TOTAL E&P
Alternates/Posters		
	164299	**Thermally Stable Cutter Technology Advances PDC Performance in Hard and Abrasive Formations, Kuwait** A. Hussein, N.A. Al-Anezi, A.Q. Al-Sarraf, A.K. Dhabria, H.A. Baqer, Kuwait Oil Company; H. Maliekkal, O. Ghoneim, Y. Zhang, Smith Bits, a Schlumberger Company
	164213	**New Generation PDC Bits Set New Benchmarks in Carbonate Drilling, Resulting in Significant Performance Improvements and Cost Savings** A. Al-Hinaai, M. Cruz, M. Geraud, C. Ivers, I.K. Butt, Baker Hughes
	164176	**Successful Pilot Installation of Retrofit Gas Lift System Allows Resumed Production** A. Whittaker, Weatherford International; F. Rattray, Marathon Oil Company
	164154	**High-Torque RSS with Application Specific PDC Bit Establish New Field Footage Benchmark** K.A. Al-Saati, M.A. Qadmani, Al-Khafji Joint Operations; C.A. Hammoutene, A.W. Noureldin, M.M. Shaker, Schlumberger

SESSION 8 | ROOM 2 | 1400-1600

UNCONVENTIONAL DRILLING METHODS

SESSION CHAIRPERSONS:
Alasdair Shiach, *Baker Hughes and* ***Nazar Al-Tarif,*** *Tatweer Petroleum*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164366	**Introducing an Innovative Solution for the Age-Old Drilling Problem of Wellbore Stability** C.H. Kirby, A.O. Mohamed, Baker Hughes; O. Alvares, M. Kah, Saudi Aramco
1430	164379	**A New Pressure Testing for Low-Mobility Unconventional Formations: A Synthetic Case Study Based on Field Data** H. Hadibeik, C. Torres-Verdín, UT Austin; M.A. Proett, D. Chen, S. Eyuboglu, Halliburton
1500	164221	**Industry's First Hydro-Mechanical Surface Controlled System for Multiple Reamer Activation/ Deactivation Increases Drilling Efficiency** B.T. Torvestad, H.M. Bjorneli, K. Torge, L. Andreassen, Schlumberger; S. Haavardstein, ConocoPhillips
1530	164386	**Performance Evaluation of a Nano Silica Based Cement Slurry for Oil Well Cementing** M.K. Rahman, A.A. Al-Majed, S. Amer, A. Idrissu, King Fahd University of Petroleum and Minerals; S.S. Jennings, S.M. Ammari, Saudi Arabian Oil Company
Alternates/Posters		
	164193	**Innovative Rolling PDC Cutter Increases Drilling Efficiency Improving Bit Performance in Challenging Applications** Y. Zhang, R.N. Baker, Y. Burhan, J. Shi, C. Chen, Smith Bits, a Schlumberger Company
	164319	**Hybrid Drill Bit Combining Fixed-Cutter and Roller-Cone Elements Improves Drilling Performance in Challenging Application in the Western Desert** A. Ismail, S. Hussein, D. Eckstrom, M. Shawkat, Baker Hughes, O. Kamel, BJ Staal, A. El Shafy Ibrahim, Khalda Petroleum Company
	164439	**Dual Gradient Drilling Technology, Its Challenges and Advantages** A. Charan, Rajiv Gandhi Institute of Petroleum Technology
	164222	**Expanding the Operational Sidetracking Window Leads to Application Based Solutions** C. Dewey, P.C. Desai, Schlumberger

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

MONDAY, 11 MARCH 2013

TUESDAY, 12 MARCH 2013

WEDNESDAY, 13 MARCH 2013

SESSION 9 | ROOM 3 | 1400-1600

RESERVOIR MANAGEMENT

SESSION CHAIRPERSONS:
Benoit Loiseau, *Total E&P and*
Ali Al-Meshari, *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1400		 KEYNOTE SPEAKER Egbert Imomoh 2013 SPE President NON-EXECUTIVE CHAIRMAN AND A CO-FOUNDER, AFREN
1425	164421	**Integrated Water Management Strategies in a Giant Carbonate Field** M.A. Alghazal, Saudi Aramco
1450	164192	**A Successful Deployment of LWD Technique for Water Shut-Off Application – Integrated Teamwork Approach Managed to Activate Horizontal Wells Economically** A.B. Al-Katheeri, M.M. Kenawy, M.H. Metwali, M.K. Bazuhair, ADCO
1515	164356	**Integrated Workflow to Evaluate and Understand Well Performance in Multi-Layer Mature Gas Reservoirs, Bahrain Case Study** H. Al-Ghadhban, F. Kadhim, Tatweer Petroleum; M.M. Eisa, A. Kumar, Z. Zaouali, H. Chaabouni, Schlumberger
1540	164337	**Strategic Scope of Alternative Optimisation Methods in History Matching and Prediction Workflows** R. Schulze-Riegert, O. Pajonk, N. Kueck, F. Chataigner, SPT Group; J. Baffoe, I. Ajala, Technology University Clausthal

Alternates/Posters

TIME	PAPER NO	TITLE AND AUTHORS
	164246	**Reservoir Compartmentalisation: "The Art of Data Integration Beyond the Pale of Fault Seal"** S. Alzaabi, ADNOC
	164414	**Vertical Cased Producers Outperform Horizontal Wells in a Complex Naturally Fractured Low Permeability Reservoir** D.R. Widjaja, S. Lyngra, F.A. Al-Ajmi, U.F. Al-Otaibi, A.H. Alhuthali, Saudi Aramco
	164242	**Next Generation Field Management for the Coupling and Optimisation of Multiple Reservoirs and Networks** H. Abbas , S.Z. Jilani, Schlumberger Oilfield UK; B. Guyaguler, Chevron

SESSION 10 | ROOM 4 | 1400-1600

CHEMICAL APPLICATIONS FOR OIL AND GAS PRODUCTION

SESSION CHAIRPERSONS:
Isa Janahi, *BAPCO and*
Abdulla Al-Azmi, *Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164175	**Successful Asphaltenes Cleanout Field Trial in On-Shore Abu Dhabi Oilfields** S. Misra, D. Abdallah, S. Al-Nuimi, ADCO
1430	164258	**Selection of Commercial Kinetic Hydrate Inhibitors Using a New Crystal Growth Inhibition Approach Highlighting Major Differences Between Them** P. Glenat, Total
1500	164335	**Enhancement of Heavy Oil Demulsification** A.J. Wiggett, Baker Hughes; T. Ricza, MOL
1530	164350	**Effect of Water Fraction on Surfactant Stabilised Water-in-Oil Emulsion Flow Characteristics** M. Al-Yaari, I. Hussein, A. Al-Sarkhi, King Fahd University of Petroleum and Minerals; M. Abbad, F. Chang, Schlumberger; B. Abu-Sharkh, IDEA International

Alternates/Posters

TIME	PAPER NO	TITLE AND AUTHORS
	164452	**Filter Cake Clean-up Using a New Acid System for HT/HP Applications** A.M. Al-Moajil, H.A. Nasr-El-Din, Texas A&M University
	164287	**Construction of Bulk Handling Facilities for Production Chemicals in S&EK, WK, and NK Areas** M.A. Awan, S.M. Al-Khaledi, Kuwait Oil Company
	164233	**Rock Dissolution of Egyptian Carbonate Reservoirs – An Experimental Approach** S.A. Shedid, British University in Egypt
	164376	**Foamer Application for Sajaa Asset Gas Wells** B. Poulose, A.J. Wiggett, Baker Hughes; M. Al-Hamadi, Petrofac

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 11 | ROOM 5 | 1400-1600
PRODUCTIVITY ENHANCEMENT 1

SESSION CHAIRPERSONS: ***Faisal Nughaimesh,*** *Saudi Aramco and* ***Mohamed Ahmed Nasr Eldin Mahmoud,*** *King Fahad University*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164453	**Comprehensive Reservoir Assessment and Refracturing Improve Saudi Arabian Gas Well Deliverability** Z. Rahim, Saudi Aramco
1430	164409	**Fracture Conductivity Improvement Using a New Proposed Methodology** L. Sierra, Halliburton
1500	164165	**Unconventional Gas Stimulation by Creating Synthetic Sweetspot** A.R. Al-Nakhli, Saudi Aramco
1530	164273	**New Insights into Surfactant System Designs to Increase Hydrocarbon Production** W.A. El Sherbeny, L. Quintero, M. Anwar, D. Moussa, Petrobel; D.A. Bakr, T.A. Jones, Baker Hughes
Alternates/Posters		
	164152	**Sand Consolidation by Resin Injection in a Sandstone Reservoir in Saudi Arabia** A.A. Al-Mulhem, Saudi Aramco

SESSION 12 | ROOM 6 | 1400-1600
MEASUREMENTS AND FLOW ASSURANCE

SESSION CHAIRPERSONS: ***Mubarak Al-Mutaiti Al-Mutairi,*** *Kuwait Oil Company and* ***Saad Derweesh,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164211	**Compatibility Analysis of Hydrate Inhibitors with Offshore Gas Pipeline FBE Internal Coating** B.A. Harbi, M. Dossary M. Espedal, Saudi Aramco
1430	164184	**Asphaltene Precipitation From Crude Oils: How To Predict it and to Anticipate Treatment?** N. Passade-Boupat, H. Zhou, Total; M. Rondon Gonzalez, Total Petrochemicals France
1500	164442	**Feasibility of a Nuclear-Free Multiphase Flow Meter Based on Combination of a Ultrasonic Doppler Velocity Sensor with a Venturi** S. Huang, C. Xie, C.P. Lenn, Schlumberger
1530	164443	**From Empirical to Micro-scale Modelling of Multiphase Flow; Bridging the Gap of R&D** A.M. Al-Qahtani, A.S. Sultan, L. Hadhrami, King Fahd University of Petroleum and Minerals
Alternates/Posters		
	164153	**Custody Measurements Best Practices** K.A. Suwaidan, Kuwait Oil Company
	164159	**Results from First Campaign of Field Testing of Multiphase Flow Meters Conducted in Saudi Arabian Wet Gas-Condensate Producers** R.V. Rodriguez, J.A. Leal, S. Hussain, M. Atwi, A. Ruwaished, Saudi Aramco; F. Garzon, BP
	164275	**Production Inside Gas Hydrates P&T Zone Using LDHI-AA Additives: A Very Promising Chemical Injection Option Against Hydrate Plugging Risk of Production Systems** P. Glenat, Total
	164278	**Evaluation of the Pressure Drop due to Multi-Phase Flow in Horizontal Pipes Using Fuzzy Logic and Neural Networks** M. Gadallah, M. Mahmoud, King Fahd University of Petroleum and Minerals

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 13 | **ROOM 1** | 1645-1845

GEOSTEERING

SESSION CHAIRPERSONS:
Michael Bittar, *Halliburton and* ***Nezar Talhah,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164257	**Successful Geosteering and ICD Completion in Flank Areas of Mauddud Carbonate, North Kuwait: Lessons Learned and Experiences Gained** S.R. Nair, H.B. Chetri, H.Z. Al-Ajmi, Kuwait Oil Company
1715	164282	**Hydrocarbon Mobility Steering for Optimum Placement of a Power Water Injector above Tar Mats: A Case Study from a Light Oil Carbonate Reservoir in the Middle East** C.L. Saint, Baker Hughes; T.M. Glowig, Baker Hughes
1745	164238	**Robust and Advanced Drilling Tools for Challenging Fields** S. Sonar, A. Purohit, V. Ganthade, Halliburton
1815	164220	**Logging While Driiling Resistivity Images for Geosteering** M. Bazara, J. Maalouf, Schlumberger

Alternates/Posters

	164188	**High-Resolution LWD Resistivity Images for Carbonate Facies Identification and Geosteering** S. Mahiout, S.A. Morris, Baker Hughes
	164194	**Advanced FEA-Based Modelling System Successfully Reproduces and Solves RSS Hole Spiraling Issue** M. Al-Hebsi, T. Stephens, Y. Owodunni, Al Hosn Gas; Y. Shen, Smith Bits, a Schlumberger Company; O. El Amin, M.A. Mokhti, P. Le, V. Radhakrishnan, R. Boualleg, Schlumberger
	164390	**Heavy Oil Field Development Using Innovative Approach** M.A. Al-Sharafi, Schlumberger
	164284	**Steering with the Multifunction LWD Tool Achieves Optimum Results in High Structural Dip Uncertainty Field in Egypt** P. Swire, Y. Badr, East Zeit Oil Company; Z.J. Ramadan, T. Khattab, M.M. Siam, J.T. Dolan, E. Samir, A. Khattab, Schlumberger

SESSION 14 | **ROOM 2** | 1645–1845

RESERVES AND ECONOMICS

SESSION CHAIRPERSONS:
Hifaa Al-Bader, *Kuwait Oil Company and* ***Jamal Khunaifer,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164265	**Reservoir Model Updating and Value of Information Using Probabilistic Economic Forecasting** H. Singh, S. Srinivasan, The University of Texas at Austin
1715	164136	**Toward Efficient Oil Price Modelling: A Predictive Oil Price Behaviour based on Historical Data and its Projection to the Future** A.M. Al-Menhali, ADCO; N. Abou Sayed, O. Younas, H.A. Belhaj, The Petroleum Institute; Z. El Mahmoud, GASCO
1745	164180	**Unconventional Oil is Onset Risks for the Traditional Producers** E. Grushevenko, Energy Research Institute of Russian Academy of Science
1815	164426	**Oil and Gas Project Cost Estimation By Using Gold Price Model (Gold Equivalency)** C. Nugraha, BPMIGAS

Alternates/Posters

	164186	**More Accurate Method to Estimate the Original Gas in Place and Recoverable Gas in Overpressure Gas Reservoir** K. Ling, University of North Dakota
	164255	**The Use of Two-Phase Compressibility Factors in Predicting Gas Condensate Performance** I. Arukhe, Saudi Aramco; W. Mason, Robert Gordon University
	164463	**Preparing for the Upcoming Challenges in Project Execution When the Next Market Boom Hits the Region** A. Carbery, Contax Partners
	164296	**Systematic Portfolio Analysis for Efficient Hydrocarbon Maturation** E.B. Zijlstra, Y.M. Aufi, Petroleum Development Oman

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 15 | ROOM 3 | 1645–1845

REAL-TIME MANAGEMENT AND PROJECT MANAGEMENT

SESSION CHAIRPERSONS:
***Abdullatif Omair,** Saudi Aramco and **Scott Bittner,** Schlumberger*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164291	**Real-Time Management of E&P Data using GIS for Bahrain Field Monitoring** N.K. Puripanda, K. Kumar, V. Prasad, A. Al-Anaisi, C. Reddy, Bahrain Petroleum Company (BAPCO)
1715	164151	**Real-Time Log Prediction Using Horizontal Well Correlation in Geosteering Complex Reservoirs of Saudi Arabia** A.A. Al-Maskeen, R.R. Sung, S.S. Ali, Saudi Aramco
1745	164404	**Managing Changes in Workforce, Practices and Operations: Virtual Resourcing for Oilfield Projects to Utilise Global Experience and Best Practices** A. Alvi, M. Doghmi, Schlumberger
1815	164304	**The Art and Science of Project Risk Management** G. Unnikrishnan, Kuwait Oil Company
Alternates/Posters		
	164437	**Real-Time Data: An Automatic and Dynamic Software Structure for Validating Massive Data Streams** D. Al-Sana, Saudi Aramco
	164205	**Upstream Data Standards at Saudi Aramco** F. Al-Sanie, M. Shehry, M. Khudiri, R. Miyajan, A. Taiban, Z. Ahmed, M. Khakwani, Saudi Aramco
	164431	**Adaptive Web Servers Based on Hosted Applications** H. Alsaeed, Saudi Aramco
	164166	**Real-Time Prediction of Pore Pressure Gradient in Oil and Gas Wells: An Artificial Neural Network Approach** R. Keshavarzi, R. Jahanbakhshi, IAU Science and Research Branch

SESSION 16 | ROOM 4 | 1645–1845

FACILITIES MANAGEMENT AND OPTIMISATION 1

SESSION CHAIRPERSONS:
***Isa Janahi,** BAPCO and **Faud Al-Shaikh,** Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164210	**Quick Gas Production Increment by Optimisation of Pressure Control Valves on Gas Condensate Wells. A Field Case in Saudi Arabia** R.V. Rodriguez, J.A. Leal Jauregui, S.O. Bolarinwa, M. Dhamen, M. Buali, S. Driweesh, Saudi Aramco
1715	164208	**Best Practices – Asset Management Process Supported by Reliability Analysis** A.E. Al-Adwani, Kuwait Oil Company
1745	164262	**Thermal Simulation Coupled with Facilities Model – Optimisation Case Study** O. Talabi, A. Alvi, M. Giddins, Schlumberger
1815	164206	**A Pragmatic Approach for Promoting Local Proppant in International Business** P. Das, R. Kothamasu, P.B. Karadkar, Halliburton
Alternates/Posters		
	164464	**Field Experience with the First Twin-Screw Multiphase Pump in a Saudi Aramco Oil Field** R.S. Al-Anazi, Saudi Aramco
	164209	**Best Practices Sharing-Natural Gas Processing Operations Enhancement by Six Sigma Techniques** A.E. Al-Adwani, Kuwait Oil Company
	164340	**Oilfield Development Inside Populated Urban Areas: Challenges and Opportunities** M.A. Al-Dossary, F. Al-Mutairi, Saudi Aramco

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 17 **ROOM 5** 1645–1845

ARTIFICIAL LIFT 1

SESSION CHAIRPERSONS:
Donald Yeager, *ExxonMobil and* ***Nader Douhan,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164328	**Improving Artificial Lift Performance with Root Cause Failure Analysis (RCFA)** S.G. Lapi, M.E. Johnson, ExxonMobil; A. Bookout, GE Oil and Gas
1715	164382	**Electrical Submersible Pump Surveillance and Optimisation Solutions: Ensuring Best Performance and Optimum Value** A.S. Al-Maghlouth, M. Cumings, M.A. Awajy, A.A. Al-Amer, A. Albar, Saudi Aramco
1745	164189	**Case Study in Kuwait for Beam Pump Automatic Speed Control and Optimisation** A.A. Metwally, N. Fawzi, J.A. Alrubaiyea, Kuwait Gulf Oil Company; N.N. Sadek, Lufkin Automation; I. Kamel, Fawares Petroleum Services
1815	164469	**Harnessing of Coal Energy Through Underground Coal Gasification (UCG) in India – Opportunities and Challenges in Processing and Utilisation of Syngas** K.C. Dani, University of Petroleum and Energy Studies

Alternates/Posters

	PAPER NO	TITLE AND AUTHORS
	164249	**Designing ESP Completion Architectures to Meet Production Requirements** L.A. Camilleri, P. Gambier, Schlumberger
	164228	**Selection and Optimisation of Artificial Lift System in Heavy Oilfields** V. Kaplan, S. Sahin, E. Duygu, Turkish Petroleum Corporation
	164377	**Artificial Lifting of High Productivity Wells: A Production Optimisation Scheme** A.M. Al-Qahtani, Petro ART
	164316	**Coiled Tubing as a Sucker Rod as well as Production String in Dual Zone Completion** R.P. Parekh, K. Desai, Pandit Deendayal Petroleum University

SESSION 18 **ROOM 6** 1645–1845

WELL AND ASSET INTEGRITY

SESSION CHAIRPERSONS:
Basil Elzein, *Shell and* ***Hussein S. El-Sayed,*** *ADMA-OPCO*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164230	**Well Integrity Management System (WIMS): Coupled Engineering Analysis** R. Samuel, O. Germain, Halliburton
1715	164415	**Case History: Innovative Milling Operation of Stuck Wellhead Tubing Master Valve using Coiled Tubing at South Ghawar Field, Saudi Arabia** A.M. Al-Shehri, A.A. Mukhaitah, S. BuHassan, I.M. Zefzafy, Saudi Aramco
1745	164173	**Improving Reliability of Surface Safety Valves by Up Gradation with Self Contained Hydraulic Retrofit for Sour Services** C.A. Parikh, F. Al-Azmi, N. Al-Hajeri, Kuwait Oil Company
1815	164370	**Innovative Methodology to Restore the Functionality of the Sub-Surface Safety Valves with Damaged Control Line Without Rig Interventions** M.A. Fahim, ADCO

Alternates/Posters

	PAPER NO	TITLE AND AUTHORS
	164425	**Systematic Approach to Integrate a Comprehensive Surface and Subsurface Well Integrity Management System** K.S. Al-Yateem, ARAMCO Services Company
	164185	**Downhole Machining: Reality or Myth?** F. Allan, Al-Mansoori Wireline Services
	164303	**Asset Integrity Management System Implementation in KOC** C. Rezaei, A.A. Abbas, Kuwait Oil Company

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

TUESDAY, 12 MARCH 2013

SESSION 19 | ROOM 1 | 1400-1600 — DRILLING IN HIGH PRESSURE/ HIGH TEMPERATURE

SESSION CHAIRPERSONS:
Manaf Arnous, *Weatherford and* ***Dakhil Al-Enezi,*** *Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164466	**Production Optimisation Strategy with Hydraulic Fracturing in a Challenging Deep and Hot Reservoir Utilising High-Temp Fracturing Fluid** A.M. Omair, Saudi Aramco
1430	164371	**New Generation Ultra-High Temperature Synthetic-Based Drilling Fluids; Development and Best Practices for Extreme Conditions and ECD Management** P. Marinescu, G.R. Iskander, M-I SWACO
1500	164432	**Enhanced Fracturing Fluids for High-Pressure High-Temperature Sensitive Sandstone Formations** M. Al-Amoudii, Saudi Aramco
1530	164454	**A Consistent Arbitrary Water Saturation Initialisation and Dynamic Capillary Pressure Modelling** U. Middya, Saudi Aramco
Alternates/Posters		
	164148	**Modelling of Effect of Thermal Stresses and Mud Flow on Wellbore Stability Analysis of Hpht Wells** R.R. Kumar, Schlumberger Asia Services Limited
	164338	**Successful Application of Metal-Crosslinked Fracturing Fluid with Low-Polymer Loading for High temperature Proppant Fracturing Treatments in Saudi Arabian Gas Fields – Laboratory and Field Study** A.R. Malik, S. Bolarinwa, L. Jairo Alonso, J. Duarte Olarte, Saudi Aramco; J.R. Vielma, J. Soriano, Halliburton

SESSION 20 | ROOM 2 | 1400-1600 — RESERVOIR MONITORING AND WELL TESTING 1

SESSION CHAIRPERSONS:
Turgay Ertekin, *Pennsylvania State University and* ***Benoit Loiseau,*** *Total E&P*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164234	**Improved Reservoir Surveillance through Injected Tracers in a Saudi Arabian Field Case Study** M. Al-Mosa, Saudi Aramco
1430	164353	**Seismic Reservoir Monitoring of a Thermal EOR Redevelopment; Thick Heavy Oil Field in Oman** R.S. Al-Adawi, G. Rocco, A. Al-Maamari, F. Al Kindy, S. Al-Busaidi, Petroleum Development Oman; J.L. Lopez, D. Kiyashchenko, W. Berlang, Shell
1500	164269	**Using Reservoir Simulation for Enhancing the Capabilities of Gravity Monitoring of the Oil-Water Flood Front** G. Dyatlov, A. Vasilevskiy, Y. Dashevsky, C.M. Edwards, D.T. Georgi, Baker Hughes; A.M. Loermans, Saudi Aramco
1530	164330	**Analytical and Numerical Modelling of Tracer Flow in Oil Reservoirs Containing High Permeability Streaks** I. Kocabas, Batman University; F. Maier, University of Göttingen
Alternates/Posters		
	164392	**CO_2-Flood and Sequestration Monitoring Using a Borehole Transient Electromagnetics System: A Feasibility Study** S.M. Dutta, D.T. Georgi, A. Reiderman, Baker Hughes
	164236	**A Field Case Study of Interference Testing Using Multiple Horizontal Wells** T. Sanyal, H. Baroon, I.A. Ali, Kuwait Oil Company
	164281	**Pushing the Limits of Distributed Temperature Survey Analysis in Mega-Reach Power Water Injectors** T.A. Elsherif, W. Kharrat, F. Baez, Schlumberger Middle East SA.; M.A. Al-Dhufairi, L. Duthie, K.A. El-Kilany, Saudi Aramco
	164219	**Leveraging I-Field Data for Full Field Dynamic Reservoir Characterisation** B.A. Al-Wehaibi, S. BinAkresh, M. Issaka, S. Al-Shamrani, Saudi Aramco

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 21 | ROOM 3 | 1400-1600
FLUID AND ROCK CHARACTERISATION

SESSION CHAIRPERSONS:
***Adel Hussain Malallah**, Kuwait University and **Nawzad Khurshid,** Occidental Oil & Gas*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164251	**Capillary Pressure and Permeability Prediction in Carbonate Rocks – New Methods For Accurate Prediction of Matrix Properties** I. Hulea, Shell
1430	164354	**Integrated Rock-typing with Capillary Pressure Curve Clustering** F. Fournier, G. Fabre, C. Aug, Beicip-Franlab
1500	164224	**Characterisation of Hydrocarbon Fluids for Integrated Production Models** M. Kathrada, Petroleum Development Oman
1530	164239	**Downhole Analysis and Laboratory Analysis, Key Complementary Technics for a Comprehensive and Effective Fluid Characterisation** S.H. Al-Sabea, M.A. Al-Rushaid, A.A. Mohamed, Kuwait Oil Company; F.D. Bouchet, K.K. Harami, H.A. Ayyad, K. Slimani, M. Al-Khabbaz, P.R. Aguilera, Schlumberger
Alternates/Posters		
	164357	**Quantitative Viscosity and Movable Oil Evaluation in a Complex Carbonate Reservoir using Advanced Dielectric and NMR Log Integration: A Case Study** A. Iqbal, O. Yepes, D. Reddie, R. Gamal, Saudi Arabian Chevron (Wafra/Kuwait); M.A. Rampurawala, A. Hussain, P. Sangani, Schlumberger; S. Palar, Chevron; A. Al-Hajri, Kuwait Gulf Oil Company; A. Bilal, LMKR
	164349	**Innovative Single Phase Tank Technology for In-Situ Sample Validation Enhances Fluid Sampling Integrity** F. Galvan Sanchez, Baker Hughes
	164308	**A First Principle Expression of Matrix Permeability in Porous Media Such as Multi-Modal Carbonates** J.J. Buiting, E.A. Clerke, T.R. Pham, J.P. Fontanilla, D. Shehri, Saudi Aramco
	164140	**Advances in SCAL Data Interpretations on Multi-Scale Measurements from Different Carbonate Rock Types in a Giant Oilfield in Abu Dhabi** S. Serag El Din, K. Zubair, ADCO; M. Dernaika, Ingrain

SESSION 22 | ROOM 4 | 1400-1600
DESIGN, MATERIAL SELECTION, AND CORROSION MANAGEMENT

SESSION CHAIRPERSON:
***Basil Elzein,** Shell*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164393	**Saudi Aramco Practices for Mitigation of Sweet Gas Corrosion** M.E. Alharbi, Saudi Aramco
1430	164182	**Remote Gas Fields Development: Challenges and Experience** O.I. Aguji, M.A. Al-Dossary, Saudi Aramco
1500	164190	**Corrosion Monitoring for Kuwait's Pipeline Network System** S. Prakash, A.R. Al-Shamari, S. Al-Sulaiman, A. Jarragh, A. Al-Mithin, Kuwait Oil Company
1530	164325	**Modular Design for Low Cost Minimum Facilities Platforms** G. Nicholson, IMechE
Alternates/Posters		
	164201	**Field Experience in Identification of HIC in Pressure Vessels** S.M. Hari, V. Sardesai, S. Al-Sulaiman, B. Al-Harbi, Kuwait Oil Company; S.A. George, INTREX
	164198	**The Impact of Black Powder on Gas Plant Safety Relief Valve Isolation Valve** K.A. Al-Jumayiah, Saudi Aramco
	164231	**Effectiveness of CP for Buried Flowlines near Gathering Centers** H. Sabri, A. Al-Mithin, S. Al-Sulaiman, Kuwait Oil Company

SESSION 23	ROOM 5	PRODUCTIVITY ENHANCEMENT 2
1400-1600		SESSION CHAIRPERSONS: ***Sultan Masoud Al-Merikhi,*** *GDF Suez and* ***Meshal Dawood Al-Khaldy,*** *Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164270	**New Technologies and Standards in Well Construction and Fracturing for Shale-Gas Wells are Helping to Reduce Environmental Concerns** R. Sweatman, A.D. Nakhwa, K. Huggins, Halliburton
1430	164326	**Dual Lateral Open Hole Coiled Tubing Acid Stimulation in Deep HPHT Sour Gas Producer Wells – Field Experience and Lessons Learned from Ghawar Field** M.R. Alzaid, M.A. Alghazal, A. Al-Sagr, Saudi Aramco; J.R. Vielma, J.A. Noguera, Halliburton; C. Alejandro, Boots-Coots
1500	164248	**Reactivating a Tight Carbonate Reservoir in the Greater Burgan Field: Challenges, Options, and Solutions** V.S. Chimmalgi, N.H. Gazi, J. Al-Humoud, A. Mudavakkat, E. Abdul Razzaq, M.J. Ahsan, J. Bardalaye, Kuwait Oil Company
1530	164305	**Evaluating the Impact of Natural Fractures, In-Situ Stress and Mineralogy on Hydraulically-Induced Fracture System Geometry in Horizontal Shale Wells** C.K. Miller, M. Singh, J.H. Le Calvez, Schlumberger
Alternates/Posters		
	164380	**Carbonate Stimulation with Biodegradable Chelating Agent Having Broad Unique Spectrum (pH, Temperature, Concentration) Activity** E.A. Reyes, A. Smith, A. Beuterbaugh, Halliburton
	164245	**Quantitative Modelling of Acid Wormholing in Carbonates – What are the Gaps to Bridge** X. Qiu, W. Zhao, F. Chang, Schlumberger
	164183	**Multi-Stage Large Scale Hydraulic Fracturing in Horizontal Well, a First in India** S.M. Stolyarov, Baker Hughes; D. Jackman, Oilex
	164456	**Evolution of Multi-Stage Fracturing Technology Application for Tight Gas Wells in Saudi Arabia** A. Halim, Saudi Aramco

SESSION 24	ROOM 6	FACILITIES MANAGEMENT AND OPTIMISATION 2
1400-1600		SESSION CHAIRPERSONS: ***Faud Al-Shaikh,*** *Kuwait Oil Company and* ***Nasser Al-Mossalli,*** *BAPCO*

TIME	PAPER NO	TITLE AND AUTHORS
1400	164214	**The Best Practice of Urban Planning** H.K. Shabibi, P.S. Leighton, Petroleum Development Oman
1430	164289	**Improved Crude Oil Dehydration and Desalting in Mature Fields** E.L. Sellman, G.W. Sams, S. Mandewalkar, Cameron Process Systems
1500	164395	**Innovative Ethane Liquefaction Process through Cryogenics** A. Alghamdi, Saudi Aramco
1530	164352	**Start-up Without Flaring** H. Gauthey, Technip France
Alternates/Posters		
	164149	**Operational Challenges in Managing High CO_2 Content Gas Production, Peninsular Malaysia Operations, PETRONAS Development and Production** S. Hadi, Petronas Carigali Sdn Bhd
	164332	**Energy Conservation Through Flare Reduction** M.S. Al-Dhahli, Petroleum Development Oman
	164156	**Salt Water Disposal System Modification During Low Water Flow Rates from Khurais Fields** M. Al-Juaid, M. Al-Muaibed, F. Randall, A. Khan, A. Al-Doosary, M. Al-Jubran, S. Al-Shammary, Saudi Aramco
	164302	**Lean Culture Initiative Improves Productivity and On-Time Delivery for Middle East Assembly, Maintenance and Overhaul Organisation** S. Morad, Baker Hughes

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 25 | ROOM 1 | 1645-1845

DRILLING FLUIDS

SESSION CHAIRPERSONS:
Alasdair Shiach, *Baker Hughes and* ***Abdullah S. Yami,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164177	**Drilling and Completion Fluids Design for Horizontal Well Drilling - Case History from Raudhatein Field** P.B. Jadhav, Baker Hughes
1715	164383	**Next Level of Shale Inhibition: Micro-Pore Shale Sealant Using Nano-Silica Particles** P. Marinescu, S. Young, G.R. Iskander, M-I SWACO
1730	164162	**Dendrimers and Dendritic Polymers - Application for Superior and Intelligent Fluid Development for Oil and Gas Field Applications** M. Amanullah, A.S. Al-Yami, Saudi Aramco
1815	164277	**Evaluation of Ilmenite as a Weighting Material in Oil-Based Drilling Fluids for HPHT Applications** J. Xiao, S. Elkatatny, H.A. Nasr-El-Din, Texas A&M University; M. Al-Bagoury, Elkem Materials Limited
Alternates/Posters		
	164339	**Rapid Application of New Solution Maintained Wellbore Integrity in Fractured Carbonate Formation** J.J. Szabo, T. Lewis, D.K. Clapper, Baker Hughes
	164321	**High Performance, Water-Based Fluid Rising to the Challenge in Saudi Arabia** I. Musa, A. Ansari, Saudi Aramco; N.E. Alfonzo, S. El Gammal, M-I SWACO
	164351	**Optimisation of Drilling Fluid Rheological and Fluid Loss Properties Utilising PHPA Polymer** V.C. Kelessidis, Texas A&M University at Qatar; M. Zografou, V. Chatzistamou, Technical University of Crete
	164433	**Effect of Metal Ions on the Rheology and Thermal Properties of Polymeric Lost Circulation Material** A.S. Sultan, M. Omer, King Fahd University of Petroleum and Minerals

SESSION 26 | ROOM 2 | 1645-1845

RECOVERY (IOR/EOR) 1

SESSION CHAIRPERSONS:
Nawzad Khurshid, *Occidental Oil & Gas and* ***Eddie Ma,*** *Kuwait Oil Company*

TIME	PAPER NO	TITLE AND AUTHORS
1645		 KEYNOTE SPEAKER Omer Gurpinar **Technical Director, Enhanced Oil Recovery** SCHLUMBERGER
1710	164276	**A Case Study of Effective Immiscible Hydrocarbon Injection for Enhancing Oil Recovery in a Mature Oil Field** A.J. Pearce, C. Blondeau, A.S. Madathil, Total E&P
1735	164247	**The Wafra Second Eocene Heavy Oil Carbonate Reservoir, Partitioned Zone (PZ), Saudi Arabia and Kuwait: Reservoir Characterisation, Modelling, and IOR/EOR Evaluation** W.S. Meddaugh, P. Frydl, R. Dvoretsky, S. Al-Gamdi, D. Dull, S.J. Gross, S.J. Johansen, Chevron
1800	164244	**Uncertainty Quantification of a Chemically Enhanced Oil Recovery Process: Applying the Probabilistic Collocation Method to a Surfactant-Polymer Flood** A.M. Alkhatib, P. King, Imperial College London
1825	164458	**Field Trial of a Light Oil Steam Flood Pilot in the Mauddud Reservoir, Bahrain Field** J.G. Flautero, A. Qazi, S. Darwish, I. Jaber, Tatweer Petroleum; P. Koci, PetroChem Inspection Services; D.E. Sharbak, J.A. Tasker, Occidental Oil and Gas Corporation
Alternates/Posters		
	164359	**Surfactant Flooding in Challenging Conditions: Hard Brine, High Temperature and Clayed Sandstones** R. Tabary, B. Bazin, F. Douarche, IFP Energies nouvelles; P. Moreau, F. Oukhemanou-Destremaut, Rhodia Solvay
	164226	**An Experimental Study on Chemical Flooding Using In-Situ Precipitation Inhibitor** K.A. Elraies, Universiti Teknologi PETRONAS
	164331	**The Impact of LoSalTM on Oil Recovery from Abu Dhabi Carbonate Oil Reservoir – An Experimental Approach** M.Y. Mahmoud, H.H. Al-Attar, A.Y. Zekri, M.T. Ghannam, R.A. Almehaideb, United Arab Emirates University
	164418	**Application of Fast-SAGD in Naturally Fractured Heavy Oil Reservoirs: A Case Study** A. Hemmati Sarapardeh, Sharif University of Technology; H. Hashemi Kiasari, Amir-Kabir University of Technology; N. Alizadeh, Schlumberger; S. Mighani, University of Oklahoma

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 27	ROOM 3	RESERVOIR MODELLING 2	SESSION CHAIRPERSONS: ***Philip E. Mosher,*** *Gaffney, Cline and Associates and* ***Dawood Al- Matar,*** *Kuwait Oil Company*
1645–1845			
TIME	**PAPER NO**	**TITLE AND AUTHORS**	
1645	164292	**Looking for the Hurricane in Reservoir Simulation Uncertainty Modelling** M. Kathrada, Petroleum Development Oman; A. Al-Huthali, Saudi Aramco; J.N. Carter, Imperial College	
1715	164212	**Application of a Newly Developed Workflow to Design and Optimise MRC and Smart Well Completions** S.H. Shenawi, W. Hidayat, M. Al-Shammari, K.A. Nasser, A.A. Al-Faleh, U.A. Al-Nahdi, Y. Ghuwaidi, Saudi Aramco; N. Mekki, Schlumberger	
1745	164428	**Framework Model Building in Highly Complex Structures Utiliaing Multi-Azimuth 3D Seismic Data: Case History from Bahrain Field** E. Maili, F. Tawash, D. Hoffman, Tatweer Petroleum	
1815	164317	**Forecasting of H_2S Production due to Aquathermolysis Reactions** C. Barroux, V. Lamoureux-Var, E. Flauraud, IFP Energies Nouvelles	
Alternates/Posters			
	164310	**Advanced Visualisation for Reservoir Simulation** B.M. Al Harbi, A. Al-Zawawi, A. Al-Darrab, O. Hajjar, Saudi Aramco; A. Myhre, Kongsberg Oil and Gas Technologies	
	164268	**Reservoir Simulation to Investigate the Effect of Flow Baffles in a Basin-Floor Fan, Scarborough Field, North West Shelf, Australia** J.T. Sutton, M.E. Fittall, P.N. Glenton, M.A. Moore, R.G. Heavysege, D. Box, ExxonMobil	
	164294	**Advanced Workflow for 3-D Geological Modelling of a Complex Giant Field, Greater Burgan, Kuwait** J. Filak, J. Van Lint, Beicip-Franlab; F.A. Abdulla, E.D. Ma, R.A. Al-Houti, Kuwait Oil Company	
	164333	**Enhanced Oil Recovery by Nanoparticles Injection: Modelling and Simulation** M.F. El-Amin, KAUST	

SESSION 28	ROOM 4	TIGHT AND SHALE GAS RESERVOIR CHARACTERISATION	SESSION CHAIRPERSONS: ***Philippe Simon,*** *Schlumberger and* ***Saleh Al Saleh,*** *Saudi Aramco*
1645-1845			
TIME	**PAPER NO**	**TITLE AND AUTHORS**	
1645	164263	**Steady-State Permeability Measurements on Intact Shale Samples at Reservoir Conditions – Effect of Stress, Temperature, Pressure and Type of Gas on Permeability** S. Sinha, Q.R. Passey, S.A. Leonardi, J.A. Boros, A.C. Wood, T. Zirkle, R.A. Kudva, ExxonMobil Upstream Research Company; E.M. Braun, Consultant	
1715	164300	**sCore: A Classification Scheme for Organic Mudstones Based on Bulk Mineralogy** H. Gamero, C.K. Miller, R. Lewis, Schlumberger	
1730	164267	**High Resolution Diffraction Imaging of Small Scale Fractures Fields in Unconventional Shale Plays** A.M. Popovici, I. Sturzu, I. Musat, N. Tanushev, Z-Terra; T. Moser, Moser Geophysical Services	
1815	164271	**Understanding Complex Source Rock Petroleum Systems to Achieve Success in Shale Developments** R. Dusterhoft, K. Williams, M. Croy, A. Kumar, Halliburton	
Alternates/Posters			
	164347	**The Impact of Heat Flow Variations in Shale Gas Evaluation: A Haynesville Shale Case Study** A. Amer, Schlumberger Technical Services; R. di Primio, R. Ondrak, V. Unnithan, GFZ & Jacobs University	
	164427	**Overview on Use of Material Balance Equation for Shale Gas and Non-Conventional Reservoir** V.K. Singh, Pandit Deendayal Petroleum University	
	164191	**Type-Curves for Pressure Transient Analysis of Horizontal Wells in Shale Gas Reservoirs** K.S. Lee, S. Lee, T. Kim, Hanyang University	

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 29 | ROOM 5 | 1645-1845
ARTIFICIAL LIFT 2

SESSION CHAIRPERSONS:
Basil Elzein, *Shell and*
Donald Yeager, *Exxonmobil*

TIME	PAPER NO	TITLE AND AUTHORS
1645	164256	**Novel Examples of the Use of Surface Jet Pumps (SJPs) to Enhance Production and Processing: Case Studies and Lessons Learnt** S. Peeran, Caltec Limited
1715	164309	**Application of the Gas Handlers in KOC** F. Rahime, Baker Hughes; R. Suryadi, Kuwait Oil Company
1745	164250	**Candidate Well Selection for Gas Lift** A. Kassenev, M. Giddins, A. Alvi, Schlumberger
1815	164320	**Advanced Signal Analysis of an Electrical Submersible Pump Failure due to Scaling** M. Noui Mehidi, A. Bukhamseen, Saudi Aramco
Alternates/Posters		
	164388	**Improved Recovery through Application of a Enhanced Casing Exit System: A Case Study** M. Al-Harbi, Saudi Arabian Chevron (SAC); S.B. Elbalasy, Kuwait Petroleum Corporation (OSSCO); O. El-Gendy, KGOC; S. Uddin, Kuwait Oil Company; M. Aljarid, P. Ashutosh, O. Talal, Weatherford
	164446	**Evaluation of Gas Well Deliquification Technologies for the Middle East** R. Lastra Melo, J. Xiao, Saudi Aramco
	164411	**Comparative Study of Motor Heat Transfer Models in an Electrical Submersible Pump** G.C. Betonico, A.C. Bannwart, M.M. Ganzarolli, Universidade Estadual De Campinas

SESSION 30 | ROOM 6 | 1645-1845
WATER MANAGEMENT

SESSION CHAIRPERSONS:
Abdulla Al-Azmi, *Kuwait Oil Company and* ***Jamil Thuwaini,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
1645		 KEYNOTE SPEAKER Fahad A. Al-Ajmi Khurais Reservoir Management Division SAUDI ARAMCO
1510	164405	**Waterflood Optimisation and Uncertainty Reduction with Streamline Simulation: Integrating the Cycle of Monitoring, Acquisition, Analysis, and Planning for Maximum Recovery** A. Alvi, S.Z. Jilani, Schlumberger
1735	164313	**Pressure Changes Effects of the Outlet Free Water Knock Out on the Oil in Water: A Case Study for Karakus Field, Adiyaman, Turkey** E. Ergun, Turkish Petroleum Corporation
1800	164336	**Efficient Upgrading Philosophy to manage Future Effluent Water in the Kuwait Oil Company, Greater Burgan Field** R.M. Al-Wazzan, F. Ali, Kuwait Oil Company; R. Thawer, M. Robinson, AAR Energy
1825	164168	**Appraising the Performance of Cyclic Production Scheme through Reservoir Simulation, a Case Study** T.M. Al-Zahrani, Saudi Aramco
Alternates/Posters		
	164158	**Application of a New Integrated Technique for Servo Adjustable Water Detection and Water Shutoff in Sudan Oilfield** F. Zhong, Daqing Oilfield Limited Company
	164399	**Customised Downhole Flowmeter Provides Real-Time Reservoir Pressure, Temperature, and Flow Monitoring** S. Shahin, A.M. Khateeb, Baker Hughes
	164372	**Produced Water Re-Injection System Optimisation** H.H. Al-Khalifa, Saudi Aramco
	164229	**The Behaviour of Oil Spill in Water and the Way to the Best Economical and Environmental Recovery Solutions** H.A. Al-Mebayedh, Kuwait Oil Company

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

WEDNESDAY, 13 MARCH 2013

SESSION 31 | ROOM 1 | 0800-1000
WELL INTERVENTION AND CONTROL

SESSION CHAIRPERSONS:
Sultan Masoud Al-Merikhi, *GDF Suez and* ***Cliff Kirby,*** *Baker Hughes*

TIME	PAPER NO	TITLE AND AUTHORS
0800		 KEYNOTE SPEAKER Stuart Murchie **Vice President - Well Intervention** SCHLUMBERGER
0825	164243	**Well Intersection and Well Positioning Technique using Logging-While-Drilling Technology** M. Bittar, H. Wu, S. Eyuboglu, Halliburton
0850	164283	**Restoring Integrity of the Platform by Abandoning gas Producer Well Suffering From Integrity Problems** S. Mohamed, I. Al-Hosani, ADMA-OPCO
0915	164403	**Managed Pressure Drilling Technique Applied in a Kurdistan Exploration Well** S.P. Kelly, C. Leggett, J. Thain, M.A. Silva Rodriguez, Weatherford; V.C. Roes, Talisman Energy
0940	164375	**Halo Barrier Valve** M. Webster, R. Patterson J. Sloan, Baker Hughes; O.D. Bautista, Saudi Aramco
Alternates/Posters		
	164315	**Digital Slickline: Real-Time Slickline-Conveyed Plug Setting** Y. Bernard, A.B. Omidiya and S.W. Murchie, Schlumberger; A. Al-Jandal, A. Al-Kady and A. Al-Ghafly, Saudi Aramco
	164218	**Thru-Tubing Inflatable Straddle Packer Assembly Enables Selective Treatment of Multiple Zones and Improves Productivity** M.D. Kothiyal, A. Parasher, Cairn Energy India; A.H. Qutob, R.J. Cooper, G.R. Forsyth, Weatherford
	164196	**A Rigorous Method to Calculate the Rising Speed of Gas Kick** K. Ling, University of North Dakota
	164444	**Development and Field Trial of an E-line, Lateral Intervention Tool** M. Noui Mehidi, Saudi Aramco; H. Al-Khamees, Welltec

SESSION 32 | ROOM 2 | 0800-1000
RECOVERY (IOR/EOR) 2

SESSION CHAIRPERSONS:
Hasan Al-Hashim, *King Fahad University and* ***Ali Al-Youif,*** *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164341	**First EOR Single Well Injection Trials using Low Salinity Water in the Greater Burgan Field, Kuwait** R. Thawer, P.R. Cunningham, P.J. Briggs, AAR Energy; H.A. Hashem, B.A. Abrahim, F.A. Abdulla, M.A. Alnaqi, A. Al-Qattan, H. John, Kuwait Oil Company
0830	164241	**Design Challenges of Chemical EOR in High-Temperature, High Salinity Carbonates** D. Levitt, Total Petrochemicals France
0900	164438	**Waterflood Development in a Mature Fractured Carbonate Reservoir in the Bahrain Field** G. Nadeson, H. Mehmood, H. Aldurazi, F.A. Al Saati, Tatweer Petroleum; J.G. Estremadoyro, Occidental Petroleum Qatar
0930	164306	**Design of SOS-FR (Steam-Over-Solvent Injection in Fractured Reservoirs) Method for Heavy-Oil Recovery Using Hybrid Optimisation Framework** M. Al-Gosayir, T. Babadagli, J. Leung, University of Alberta; A. Al-Bahlani, Petroleum Development Oman
Alternates/Posters		
	164157	**Innovative Abrasive Jetting Selective Stimulation Utilising Fiber Optic Enabled Coiled Tubing Revive Oil Producer Wells with High Water Cut** A. Burov, F. Baez, D. Ahmed, Schlumberger; F. Subaie, F. Sultan, N. Otaibi, Saudi Aramco
	164172	**Experiment Study on a Novel Foam System for Enhanced Oil Recovery** Z. Liu, Geological Scientific Research Institute of Shengli Oilfield Company, SINOPEC

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 33 | **ROOM 3**

0800-1000

FORMATION EVALUATION AND GEOMECHANICS

SESSION CHAIRPERSONS:
Michael Bittar, *Halliburton and*
Nedhal Mushrifi, *Saudi Aramco*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164412	**From Oil-Prone Source Rock to Gas-Producing Shale Reservoir - Geologic and Petrophysical Characterisation of Unconventional Shale Gas Reservoirs** Q.R. Passey, ExxonMobil
0830	164413	**Validation of Digital Rock Physics Based Water-Oil Capillary Pressure and Saturation Exponents in Super Giant Carbonate Reservoirs** M.Z. Kalam, ADCO; A. Mock, O. Lopez, Numerical Rocks
0900	164322	**Wireline Borehole Images-LWD Wellplacement Integration to Determine Faults in Awali Field, Bahrain** D. Juandi, W.A. Al-Alqum, N. Al-Hamad, Schlumberger; H. Sultan, L. AlHashimi, Tatweer Petroleum
0930	164457	**Evaluation of Residual Oil Saturation in the Secondary Gas Cap of a Mature Carbonate Reservoir from Multi-Dimensional Magnetic Resonace Logging** B. Ofield, A. Al-Haddad, Tatweer Petroleum; D.E. Sharbak, Occidental Oil and Gas Corporation; P.J. Saldungaray, H. Bachman, S. Ur-Rehman, H. Azam, Schlumberger

Alternates/Posters

	164150	**Integration of Dielectric Dispersion and 3d Nmr Characterises the Texture and Wettability of A Cretaceous Carbonate Reservoir** A.F. Abdel Aal, K.A. Al-Daghar, M. Al-Marzouqi , B. Baguenane, ADCO; R. Ramamoorthy, J. Brahmakulam, O. Faivre, Schlumberger
	164178	**Confirmation of Water Saturation and Rock Fluid Properties Across the Transition Zone for a Major Carbonate Reservoir** A.M. Serry, S. Budebes, M. Al-Marzouqi, O. Al-Farisi, ADMA-OPCO; O. Desport, R. Ramamoorthy, Schlumberger
	164346	**Zagros Tectonics Effects on Reservoir Behaviour in the Middle East Reservoirs** E. Heydari, Baker Hughes
	164361	**Geological Modelling and Reservoir Characterisation by Integrating Formation Tester Interference Tests with Openhole Logs and Pressure Transient Tests** M. Zeybek, F.J. Kuchuk, Schlumberger; S. Ma, Saudi Aramco

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 34	ROOM 4	RESERVOIR MONITORING AND WELL TESTING 2
0800-1000		SESSION CHAIRPERSONS: ***Bander Malki,*** *Saudi Aramco and* ***Abdulla Al-Anaisi,*** *BAPCO*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164381	**Novel Surveillance Technique for Beam-Pumped Wells to Minimise Intervention and Optimise Production, South of Oman** B. Zreik, M. Shaibani, M. Azzazi, S. Guntupalli, M. Zakwani, Petroleum Development Oman
0830	164462	**Fiber Optic Coil Tubing – First Application Worldwide on Exploration DST's** H. Gill, A.A. Al-Nahdi, Saudi Aramco; W. Kharrat, T.A. Elsherif, Schlumberger
0900	164181	**Memory Pulsed Neutron Logging – Avoiding Production Shutdown Losses Caused By In-field Logistical Constraints** J.M. Bilbeisi, Baker Hughes; H. Abuchaker, ADMA-OPCO
0930	164311	**Challenges in Testing and Completion of Highly Sour HPHT Reservoir in the State of Kuwait** P. Subban, H. Al-Bader, Y. Al-Salali, V. Duggirala, M. Ayyavoo, A.R. Al-Ibrahim, A. Rajkhowa, Kuwait Oil Company
Alternates/Posters		
	164362	**Design and Analysis of Interference Tests – Application to a Seven-Spot Inverted-Pattern Waterflood Pilot in the Wara Formation of the Greater Burgan Field, Kuwait** N.H. Gazi, F.A. Abdulla, M. Al-Naqi, L. Dashti, A. Al-Qattan, Kuwait Oil Company; P. Maizeret, Schlumberger; F.A. Al-Farhan, Kuwait Foreign Petroleum Exploration Company
	164307	**Comparing Different De-Convolution Methods in Well Test Analysis of One Iranian Naturally Fractured Reservoir Parameters** M. Kamalipour, University of Calgary; A. Shahrabadi, Research Institute of Petroleum Industry
	164260	**Case Study of H_2S Dispersion at Exploratory Well Test using CFD Tools** V.R. Monjardim, S.M. Rocha, Universidade Federal do Espirito Santo; D.C. Piasseski, Schlumberger
	164217	**Profiling Pressure-Derivative Values – A New, Innovative Way to Estimate the Radii of Investigation in Heterogeneous Reservoir Systems** N.A. Rahman, S.A. Bin Akresh, Saudi Aramco

SESSION 35	ROOM 5	PRODUCTION MANAGEMENT AND OPERATIONS 2
1400-1600		SESSION CHAIRPERSONS: ***Mohammed Khamis,*** *Saudi Aramco and* ***Mehdi Samama,*** *Repsol Explorations Murzuq*

TIME	PAPER NO	TITLE AND AUTHORS
0800	164342	**Evaluating Flow Contribution and Enhancing Completion Design of Smart Well Completion** H.A. Al-Muailu, M. Al-Suwailem, S. Aldawsari, Saudi Aramco; K.S. Al-Yateem, ARAMCO Services Company;
0830	164334	**Molar Wellstream from Well Test Rates** M.F. Hoda, Petrostreamz AS; C.H. Whitson, Norwegian University of Science and Technology
0900	164232	**KOC Gas Flaring (Success Story)** A.E. Al-Adwani, Kuwait Oil Company
0930	164138	**New Method to Estimate the Surface Separators Optimum Operating Pressures** K. Ling, University of North Dakota
Alternates/Posters		
	164387	**Case Study: Unconventional Approach of Production Optimisation in Smart Horizontal Wells: A Case Study from Ghawar Field** A.A. Al-Ghamdi, R.M. Al-Zahrani, Saudi Aramco
	164445	**A World Record in a Mega Reach Well with Coiled Tubing Intervention in Saudi Arabia** J.O. Arukhe, S. Ghamdi, M. Harbi, Saudi Aramco
	164174	**Modelling, Simulation and Comparison of Common Control Techniques of Ac Induction Motor Drive** A.J. Al-Qallaf and S. Al-Khaledi, Kuwait Oil Company
	164410	**Removal of Organic Deposits from Oil Producing Wells in a Sandston Reservoir: A Lab Study and a Case History** A.A. Al-Taq, S.M. Zied, J. Saleem, H. Al-Haji, Saudi Aramco
	164274	**Challenge and Successful Application for Scale Removal in Gemsa Oil Field: A Field Study** A.H. Sayed Badawi, PICO

Subject to change. Changes after 20 December 2012 will be reflected in the onsite programme.

SESSION 36 | **ROOM 6**

0800-1000

DIGITAL FIELDS

SESSION CHAIRPERSONS:
Klaus Mueller, *Shell and*
Philip E. Mosher, *Gaffney, Cline and Associates*

TIME	PAPER NO	TITLE AND AUTHORS
0800		 KEYNOTE SPEAKER Saeed M. Al Mubarak Head of Intelligent Fields SAUDI ARAMCO
0825	164179	**Building a True Intelligent Field** R.K. Jalan, Saudi Aramco
0850	164423	**Leveraging Multiple Digital Assets to Impact Overall Production Business: A Model Framework for Achieving Strategic Business Intelligence** S. Ashley, Maersk Oil; J. C. G. Bonilla, Schlumberger
0915	164314	**Exception Based Monitoring as a Tool for Real-Time Optimisation "How to Prioritise Well Intervention in Very Large Oilfields"** B.J. Crockett, Wipro Technologies
0940	164424	**Terrestrial Wireless Broadband Enables Smart Drilling** D. Yeager, Redline Communications

Alternates/Posters

	164369	**Real-Time Data: Interactive Monitoring of Data Flow for Continuous and Reliable Data Transmission** A.A. Al-Amer, N.A. Al-Nasser, H. Al-Towaileb, A.A. Al-Amer, Saudi Aramco
	164400	**The Impact of an Infrastructure Reliability and Data Communication Index on Improving Intelligent Field Operations in an Oilfield in Saudi Arabia** S.A. Ruvalcaba Velarde, A.A. Al-Ghamdi, Saudi Aramco
	164397	**Analysis of The Main Operational Issues Involving Multiphase Flow Meters in Safaniyah Field** A. Martins, Schlumberger; S. Alsyed, N.A. Amri, J. Al-Mulla, A. Al-Mutairi, Saudi Aramco; K.S. Al-Yateem, ARAMCO Services Company

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New at MEOS 2013

In addition to static posters, this year at MEOS visit the innovative technology showcase featuring digital presentation of posters (E-posters).

One-to-one interaction with presenters

Full programme on E-posters will be available in February 2013.

Poster Sessions

MONDAY 11 - WEDNESDAY 13 MARCH 2013

Hall 2

PAPER NO	TITLE AND AUTHORS
164137	**A Practical Approach with Theoretical Base to Predict Infill Wells Production in Oil Fields** K. Ling, University of North Dakota
164139	**A New Technique to Determine the Maximum Horizontal Stress** K. Qiu, Schlumberger; N. Chen, PetroChina
164143	**Analytical Comparison of Empirical Two-Phase IPR Correlations for Horizontal Oil Wells** M. Jabbar, King Fahd University of Petroleum and Minerals; S. Al-Nuaim, Saudi Aramco
164145	**Structural Study of Nahr Umr Structure-Southern Iraq** A.A. Lazim, South Oil Company
164155	**Field Experience with Still Pipes Installation and Supporting in KOC Storage Tanks** R. Hanna Nassar, Kuwait Oil Company
164161	**Permeability Prediction from Specific Area, Porosity and Water Saturation using Extreme Learning Machine and Decision Tree Techniques: A Case Study from Carbonate Reservoir** M. Sitouah, M. Salmeen, S. Oyemakinde, Schlumberger; F.A. Anifowose, O.M. Abdullatif, King Fahd University of Petroleum and Minerals
164164	**Diagenetic Events as The Key Improvement of Carbonate Reservoir Quality in The Senoro Field, Central Sulawesi, Indonesia** D. Hasanusi, Job Pertamina - Medco
164167	**Managing Waxy Oil Wells in Marginal Fields – A Unique Experience Offshore Peninsular Malaysia** K. Cheong, PETRONAS Carigali
164169	**Renewable Energy at Kuwait Great Burgan Oil Field** M. Nayef, Kuwait Oil Company
164171	**The Evolution of Expandables: A New Era of 'Monobore Expandable' Well Construction Systems** J.A. Stringer, D.B. Farley, Weatherford
164195	**Structural Controls of Fracture Corridors in some Middle East Fields** S.I. Ozkaya, Independent Consultant
164200	**Formulating Sag-Resistant, Low-Gravity Solids-Free Invert Emulsion Fluids** V. Wagle, S. Maghrabi, D. Kulkarni, Halliburton
164202	**Characterisation of Stress and Strength Dependent Fracture Flow Properties in Carbonate Reservoirs** D. Moos, C.A. Barton, T. Finkbeiner, Baker Hughes
164203	**Sourceless Porosity and Permeability Estimation with NMR Logs While Drilling in a Carbonate Reservoir: A Case Study** A.M. Serry, O. Al-Mutwali, A.M. Al-Mansoori, ADMA-OPCO; A.C. Aki, R.C. Balliet, G. Akopyan, Halliburton
164207	**Fluvial Facies Analysis using Gamma Ray Measurements and Outcrop Studies in the Mesri and its tributary Kuej River in the Mainland Gujarat Region, India** B. Bhosle, P. Nayak, V. Kumar, H. Poonawala, Weatherford Laboratories
164227	**Impact of New Wide Azimuth Seismic in South Oman on Development Decisions** N. Al Jahdhami, M. Healey, Petroleum Development Oman
164240	**The 5 Phases of a Plant Survey (Sharing Best Practices for Effective Surveys)** A. Al-Haider, Kuwait Oil Company
164252	**Laboratory Screening of Corrosion Inhibitors for North Kuwait Oil Fields – A First Step in a Successful Corrosion Inhibition Treatment** A.A. Al-Hashemi, Kuwait Oil Company
164253	**Modelling of Shale-Swelling Behaviour in Aqueous Drilling Fluids** S. Maghrabi, D. Kulkarni, K. Teke, S. Kulkarni, D.E. Jamison, Halliburton
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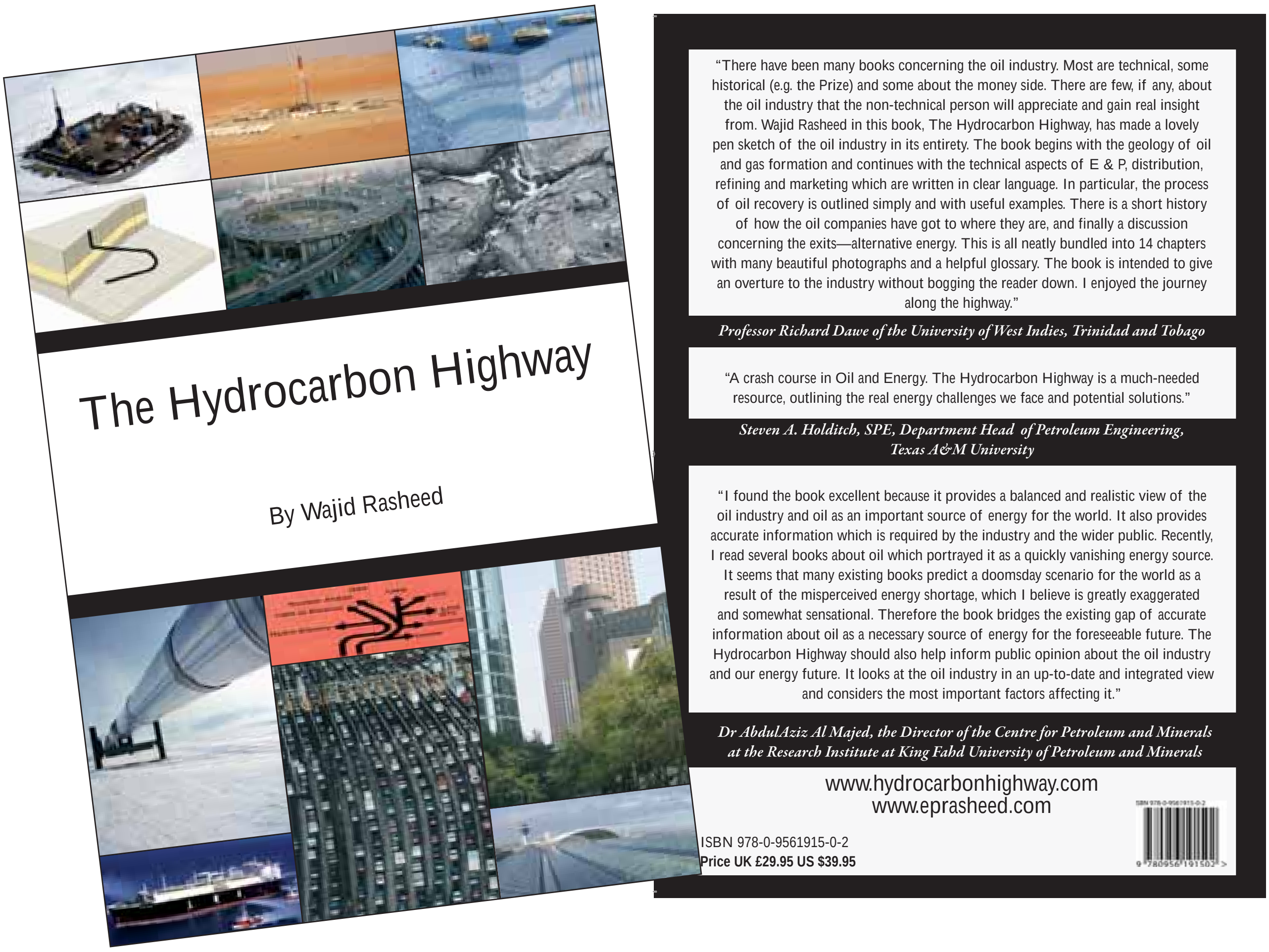
Mature Fields



Inevitably, all producing fields reach maturity one day, so the importance of mature field technology is set to grow as greater numbers of assets enter maturity. This chapter provides an overview of Enhanced Oil Recovery (EOR) and Improved Oil Recovery (IOR), as well as several practical field applications.

Pumps, polymers and permanent seismic are just a few of the technologies used to enhance and improve production in mature assets. Mature fields are challenging as they exhibit a decline in hydrocarbon rates, increased water production as well as the responsibility of decommissioning platforms, wellheads or pipelines[1].

For our purposes, a field is defined as mature once its natural reservoir drive mechanisms—gas drive, water-drive or gravity drainage—are incapable of sustaining production. Consequently, hydrocarbons must be artificially swept from the reservoir and be able to travel through production tubing, the wellbore and to surface installations[2].

Figure 1 - Nodding Donkey Or Rod Pump (EPRasheed)

Reservoir Drive

Reservoir pressure curves correlate directly with reservoir production rate curves. As long as reservoir pressure is greater than bottom-hole pressure, the differential pressure will result in production. Pressure differentials can be created by reducing bottomhole pressure or by increasing reservoir pressure, either of which will increase hydrocarbon production[3].

Following the development of low-hanging fruit, most mature assets have traditionally been distributed onshore; however, the trend now shows extensive numbers of shelf and deepwater assets entering maturity. Already, several notable offshore fields are classified as mature assets; for example, Brent and Troll in the North Sea, and Marlim in offshore Brazil.

Pump Up Production

Primary or artificial lift methods to increase production include the nodding donkey or rod pump, Electrical Submersible Pump (ESP) or a gas-lift system. During primary recovery, only a small percentage of the initial hydrocarbons in place are produced, typically around 10% for oil reservoirs and 15% for gas reservoirs[4].

Secondary production (IOR) of hydrocarbons is achieved when a fluid such as water or gas is injected into the reservoir through injection wells. Injectors are carefully drilled into formations so that fluid communication or flow pathways can be made to production wells. The purpose of secondary recovery is to increase reservoir pressure and to displace hydrocarbons toward the production wellbore[5]. As a consequence of prudent reservoir management, wells may be converted from producers to injectors or new injector wells may be drilled. The trick is to consider the entire field as a 'production unit' and manage all wells with the objective of increasing overall production. This can be a very complex and contentious issue when several landowners are involved. Imagine an oil company

> A thorough characterisation of reservoir heterogeneity and the nature of reservoir fluids is required for a mature field production strategy and only after extensive analysis of the application can a particular method be chosen.

telling a farmer that the prolific oil well on his property that is returning him a handsome revenue in royalties is about to be converted into a water injection well.

Normally, gas is injected into the gas cap and water is injected into the production zone to sweep oil from the reservoir. The mechanics of gas and water injection are complex and include consideration given to directional injectors and multi-phase flow. A pressure maintenance programme can begin during the primary recovery stage, but it is still considered a form of enhanced recovery. The secondary recovery stage reaches its limit when the injected fluid (water or gas) is produced in considerable amounts from the production wells and the production is no longer economical. For some fields this could be 50%, while for others it could be as high 80%. In Oman, wells are currently producing economic volumes of oil with over 90% water cut. The successive use of primary recovery and secondary recovery in an oil reservoir produces about 15% to 40% of the original oil in place[6]

Tertiary recovery (EOR) not only restores formation pressure, but also seeks to improve reservoir flow characteristics. With greater numbers of mature assets, oil companies target mature onshore and offshore oil fields worldwide in order to extract maximum value from sunk costs. Tertiary oil recovery applications are internationally recognised and this area of production engineering covers most categories of crude oil with American Petroleum Institute (API) grades varying from 13° to 41°. The industry adopted a broad ranging methodology, which enabled pilot testing to commercial/field applications using steam injection, carbon dioxide (CO_2) injection and polymer flood. EOR methods range from chemical flooding (alkaline or micellar-polymer based), biological flooding (microbial or bacterial based), miscible displacement (CO_2 injection or hydrocarbon injection), and thermal recovery (steam flood or in-situ combustion)[7].

Sometimes these methods are accompanied by additional stimulation services, such as hydraulic fracturing, or by drilling sidetrack lateral wells from the main wellbore to access stranded oil.

A thorough characterisation of reservoir heterogeneity and the nature of reservoir fluids is required for a mature field production strategy and only after extensive analysis of the application can a particular method be

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chosen. The application process can be split into three basic stages: modelling future behaviour, field data analysis and corrective correlation of the model[8].

Typically, data maybe collected from permanent seismic (time-lapse or 4D) or downhole equipment that monitors production. The objective is to draw up a reservoir management strategy that will address:

- The effect of recovery methods on reservoir fluids
- Migration and production of oil and gas
- Communication with adjacent reservoirs
- Sealing faults
- Fracturing
- Induced pathways due to modified permeability
- Scale formation
- Hydrogen Sulphide (H2S) mitigation, and
- Water disposal.

Analysis will include:

- Reservoir temperature
- Pressure
- Depth
- Net pay
- Permeability and porosity
- Residual oil and water saturations, and
- Fluid properties such as oil, API gravity and viscosity[9,10].

Seismic

A major goal for oil companies is to improve recovery factor for mature fields. A key method is to use imaging as a way of identifying stranded hydrocarbons and improving the efficiency of water injection. This helps mitigate the problems associated with water production, such as souring and scaling, and thus decreases the lifting costs of old fields. By using 4D seismic, and examining the differences between subsequently acquired seismic images, production geophysicists can: map reservoir drainage patterns; identify flow barriers such as faults or unconformities that are below the resolution of direct seismic imaging; and, plan the location of future injector wells.

Mature Field Applications

Water Injection

Water management is a major challenge associated with mature fields. Besides handling increasing volumes of

> "To ensure smooth transition from lab technology to field application, oil companies run pilot programmes; for example, a pilot water re-injection programme would handle say 5% of actual water volumes produced from the reservoir and re-inject this to maintain reservoir pressures."

water at surface, the challenge is to increase recovery by improving the sweep or production of hydrocarbons through water injection. This requires the correct evaluation of reservoir drainage patterns. In order to meet water management and environmental needs, oil companies are shifting from water injection to water re-injection. To ensure smooth transition from lab technology to field application, oil companies run pilot programmes; for example, a pilot water re-injection programme would handle say 5% of actual water volumes produced from the reservoir and re-inject this to maintain reservoir pressures. Water injection is easily applicable offshore where the entire ocean is available, but recently land operators have had problems finding water to inject. Farmers object to the use of aquifers for obvious reasons.

Accordingly, operators have figured ways to re-inject unwanted water produced in conjunction with the oil. This recycling solves two problems at once: it is an elegant way to dispose of the unwanted saline water that is not suitable for irrigation or drinking, and it augments oil production. Now, even offshore operators are recycling produced water because it is unlawful to dump it into the sea because of its high saline content and because it contains traces of residual oil.

To get an idea of the volumes manipulated, Petrobras handles an average water injection volume of two million barrels of oil per day (MMbbl/d) half of which come from produced water. This accounts for approximately 1.87 million barrels (MMbbl) of oil which is an average water cut of 50%. Petrobras plans to construct a system for 'raw' water injection which would be placed over the seabed and used to capture and filter water prior to injection. This has a good application on mature fields or fields whose small platforms are often space-limited[11].

H_2S in Mature Fields

The term 'souring' describes various sour gas and H_2S management strategies. The Health, Safety and Environmental (HSE) implications of water injection are well understood as injection has been ongoing in

> "Injecting nitrate to mitigate the problem and to simulate the reservoir behaviour of H_2S generation processes helps to define, for the fields under development, which strategy to adopt."

certain areas since 1978. In Brazil's Offshore Campos Basin in the Marlim field, water injection begun in 1994 and a H_2S breakthrough occurred in 2003. Injecting nitrate to mitigate the problem and to simulate the reservoir behaviour of H_2S generation processes helps to define, for the fields under development, which strategy to adopt. This approach is dependent on the forecast of how much H_2S is involved and when it will be produced[12].

If only trace H_2S volumes are expected, there is no need to act; if there are medium levels, metallurgical improvements may be selected. In addition, sulphate removal for scaling treatment may help to mitigate some of the souring problems. If levels are high, nitrates must be injected. Field pilots usually test the effectiveness of nitrate injection by having one pilot re-inject reservoir water and another pilot inject seawater. It should be noted that both would be using nitrate. These technologies are developed in conjunction with service and research companies, which are performing lab tests to help determine the simulation parameters of H_2S generation in the reservoir[13].

Salt and Scale

Offshore operations also create salt and scale problems. This can occur anywhere between surface and sub-surface equipment. Remote operations have been used successfully to perform interventions such as well cleaning and squeezing of scale inhibitors into the formation. Satellite wells using subsea Christmas trees are employed in all Brazilian deepwater fields, and remote handling avoids incurring high rig costs for intervention. The problems of corrosion and its effects on subsea installations need to be carefully considered[14].

Steam Onshore Fields

Onshore fields have seen good results from EOR using cyclic or continuous steam injection, as is demonstrated by the production of a total of 20,000 barrels per day (bbl/d). Applications in the Fazenda Alegre, onshore Espírito Santo Basin, have seen production rates improve in horizontal wells due to the introduction of thermal recovery methods. Several research projects are testing theories and feasibility of in-situ combustion. Petrobras is also considering variations of in-situ combus-tion and steam injection. The old vertical injector – vertical producer scheme – is being substituted by innovative geometries; for example, a vertical well to inject and a horizontal well to produce. Another alternative is to associate steam with solvents. This technology was recently applied in a field in the Espírito Santo Basin to mobilise oil which had not responded to steam injection alone.

Steam Assisted Gravity Drainage (SAGD) is an enhanced oil recovery technology for producing heavy oil. It involves the parallel drilling of a pair of horizontal wells spaced apart a few metres. Pressurised steam is continuously injected into the upper wellbore to heat the oil and reduce its viscosity, causing the heated oil to drain into the lower wellbore, where it is pumped out.

In all thermal recovery processes, the cost of steam generation and the availability of water will play a major part in determining whether the cost of oil production is commercially viable.

Microbial Applications

Another EOR front uses microbial applications based on water and bacterial interaction to increase production. The water and bacteria are pumped down and this is followed by nutrients. The bacteria develop a biomass that clogs the porous medium and subsequently increases the viscosity of water and diverts flow along new pathways to increase production. Biopolymers, generated by the metabolic process of the bacteria, clog the water pathways of higher permeabilities. Continuously injected water displaces the remaining oil from the lowest permeability zones. This process has been tested by Petrobras' Carmópolis field in the Sergipe Basin[15]. Alternatively, microbes are used to 'eat' clay particles that clog pore throats, thus improving permeability. A limitation to the use of microbes is their relative temperature limit. Ongoing research seeks to breed colonies of microbes that are more temperature resistant.

Modifying Relative Permeability

A neat application is the use of chemicals to control water. Water shut-off control in more than 200 wells has been achieved with the injection of a patented polymer called Selepol, which is a relative permeability modifier. Several formulations were attempted with the more recent based on tiny pieces of hydrophilic gel[16].

Drilling in carbonates or tight sands is another area of interest where stimulation technology plays a central role. There have been five fractures in a well drilled in the Enchova field, a shallow water, low permeability, light oil-bearing carbonate.

A new exploratory approach may bring into focus a new family of reservoirs of this kind, previously thought to be marginal in Brazil[17].

A novel gas management programme was designed to characterise gas reservoirs, principally for the tight sandstone Mexilhao field in the Santos Offshore Basin. The development of a gas-producing province at the Santos Basin, south of Campos, is a major goal for Petrobras and the company is focusing on stimulating flow in low permeability porous media[18,19].

Steam Injection

In the late '70s, following the discoveries of heavy oil reservoirs in the onshore part of the Sergipe-Alagoas and Ceará-Potiguar Basins, cyclical steam injection was introduced into Brazil. These first successful projects were later expanded and commercialised[20]. Subsequently, continuous steam injection was applied to a total of 15 cyclical and continuous steam injection projects covering a broad range of oil viscosities. Steam is responsible for virtually all tertiary recovery production, estimated to be presently 3% of Brazil's total oil production. In the Fazenda Alegre field, located in the onshore Espírito Santo Basin, extremely low API grade oil is being cold-produced using steam injection and horizontal wells completed with slotted liners and stem rod pumps[21].

In-Situ Combustion

Two in-situ combustion pilots were performed in the '80s in the Buracica and Carmópolis fields, and in the Recôncavo and Sergipe-Alagoas Basins respectively. The best results were obtained in the Buracica pilot, which was characterised by a low temperature oxidation process; however, sand production and well surface facility corrosion were major operational problems. Additionally, oxygen breakthrough interrupted the project due to the risk of well explosion. The Carmópolis pilot showed poorer results, despite the fact that it generated the best combustion efficiency. Poor reservoir characterisation was the main reason for losing control of the combustion. Electrical heating was tried in two heavy oil reservoirs in the Potiguar Basin as an alternative to steam injection. Results showed that the electrical heating process cannot replace steam, but can be useful in areas where steam is not applicable. Further electrical heating and water injection techniques have been applied in a pilot project conducted in the Canto do Amaro field[22].

Polymers

The first polymer injection project was implemented in 1969 in the Carmópolis field. After operating for some years, the project was interrupted but evaluations showed that an additional oil recovery of 5% could be credited to polymer injection. Besides the technical success of this project, the drop in the costs of polymers and the increasing ease with which polymer could be handled and prepared offered new opportunities to apply this technique. Currently, there are three polymer

> In all thermal recovery processes, the cost of steam generation and the availability of water will play a major part in determining whether the cost of oil production is commercially viable.

projects in course, one in the Carmópolis field and the other two being carried out in the Buracica field, Recôncavo Basin and in the Canto do Amaro field in the Potiguar Basin[23].

Water Management in Petrobras Fields and Treatment of Subsea Xmas Tree Wells

Water Flooding

Flooding is the main recovery method used in Brazil in both onshore and offshore fields. Offshore operations in the Campos Basin are responsible for a daily output of roughly 75% of the total country's output. The volumes of water injected exceed 800,000 bbl/d and the water production reaches values of over 350,000 bbl/d[24].

Due to the importance of water injection for the Petrobras fields, water management has become a major priority. Problems associated with water injection and production has been the focus of several important projects developed in the past few years.

It is worth emphasising that 'simple' problems in onshore fields, such as the stimulation of injector wells that have lost injectivity, become more complex offshore. Many wells located in deepwater areas are completed as satellites; therefore, workovers are extremely expensive due to the need for a floating rig. For such scenarios, remote operations are performed as a way of decreasing intervention costs.

A major factor in managing water is the rate of water injection that is required. The injection decline curve for injector wells must be precisely drawn in order to evaluate the economics of two options: to perform effective water treatment that requires fewer workovers or to inject lower quality 'water' that requires more frequent workovers.

Petrobras has been injecting seawater in offshore fields for twenty years. Water quality has been monitored using an index which covers parameters involved in water treatment such as injection and disposal volumes, corrosion risk, bacteria, solids and oxygen content. Irrespective of the quality of the injection programme, there is an ultimate loss of effectiveness over time. Some remote treatments using acid to remove damage in injection wells have been performed and have yielded very good results[25].

Remote Acidisation

This technique has been performed in the Marlim field which is a giant complex of oil fields located in water depths that vary from 1968 ft (600 m) to 3,445 ft (1050 m). It produces 600,000 bbl/d from high

> It is worth emphasising that 'simple' problems in onshore fields, such as the stimulation of injector wells that have lost injectivity, become more complex offshore.

permeability turbidites. To maintain reservoir pressure, an equivalent amount of water is injected daily. Despite excellent reservoir properties, injector wells lose effectiveness after a few months of water injection. Conventional acid treatments cannot be performed due to high rig costs. The solution, therefore, is to pump acid from the production platform which is often several kilometres away from the subsea Xmas tree wells. Careful laboratory tests are needed before field operations can begin to ensure that the treatment does not damage subsea equipment such as injection lines, well heads and injection columns[26].

To date, only vertical or slant cased wells have been treated. The challenge is to perform remote pumping in horizontal wells completed with slotted liners.

An alternative that may help guarantee effective water injection is to inject low quality water at pressures high enough to keep fractures open. Safe water injection requires extensive modelling of reservoir sweeps, geometry and fracture propagation[27].

Flow Assurance

Flow can be interrupted or halted altogether due to inorganic scale formation caused by seawater and reservoir water mixing together; therefore, the prediction, prevention and corrective treatment of scale is fundamental to ensure the flow of oil. The Namorado field was the largest Brazilian offshore field in the '80s and suffered from scale formation. Interventions to squeeze scale inhibitors into the rock formation were performed and oil production was maintained without interruption.

As some deepwater fields contain horizontal, uncased satellite wells, scale treatments are more difficult to perform. Nevertheless, some excellent results were achieved in the Marlim field using a special chemical process developed by Petrobras. Oil production increased by more than 13,000 bbl/d after the treatment. Again, the challenge for the next few years is the application of these treatments in horizontal uncased wells[28]. Sea floor water separation and re-injection are techniques under development[29].

Polymers

The use of polymers to control water is another potential solution and Petrobras has performed more than 170 well treatments in onshore fields. The rate of success for such treatments is in excess of 65%. The process modifies the relative permeabilities of the oil-water-sandstone system, retaining water in the wellbore vicinity. Higher seawater salinities, higher temperatures, higher permeabilities and higher produced volumes, as compared to onshore conditions, are the main challenges to be overcome offshore[30].

> "Higher seawater salinities, higher temperatures, higher permeabilities and higher produced volumes, as compared to onshore conditions, are the main challenges to be overcome offshore."

Water Disposal

Once large amounts of produced water cannot be avoided, disposal becomes the priority. The focus is on treating water to remove oil (this can be difficult due to space restrictions on platforms) in an environmentally acceptable manner so that re-injection into the reservoir or disposal in non-productive formations can be achieved[31].

Trends in Reservoir Geophysics

The challenge for seismic contractors is to increase the quality and resolution of seismic data, not only in exploration, but also in mature applications. New acquisition and seismic processing parameters oriented to reservoir characterisation and monitoring are helping improve seismic quality and resolution. With this new data set, reservoir geophysicists can potentially better understand external reservoir geometry, the internal heterogeneity of turbidite reservoirs and monitor the fluid flows. Historically, reservoir geophysicists have been using the same sequential process normally used in exploration. Nowadays, oil companies are applying new techniques such as 4D seismic adapted to reservoir needs[32].

Mature Field Seismic

In the following applications, we look at the benefits of seismic in brown fields owned by BP, Petrobras and StatoilHydro. These oil companies have successfully used the latest 4D and time-lapse seismic to maximise the life of the reservoir, characterise stacked and thin-bed reservoirs as well as monitor water injection in deepwater reservoirs. This has helped these companies reach bypassed payzones, extend production and even change the definition of what was once considered economic.

Reservoir Studies of BP's Mature Fields in the Columbus Basin, Trinidad

4D seismic accompanies the lifecycle of an oil and gas asset and can provide valuable production monitoring information. This is because, as with all technology, seismic is subject to constant improvement. Seismic shot 20 or 10 years ago would have had limited 'vision' and likely only located 'shallow' reservoirs. Today, opportunities exist to find deeper reservoirs in mature fields, which were once characterised by 2D (early less sophisticated seismic). This can be seen in the new frontiers or deep gas plays, which are being explored in the Gulf of Mexico (GOM) and in the Columbus Basin[33].

This has tremendous value in shaping decisions as to the peaking of production rates and decline curves. Usually, a cost-benefit analysis is conducted which measures costs and attributes the value gained. This exercise can be difficult as the value gained may often be indirect. 4D seismic is used mainly to better

> "The challenge for seismic contractors is to increase the quality and resolution of seismic data, not only in exploration, but also in mature applications."

manage reservoir production across the lifecycle of a field. Due to the increasing number of brown fields worldwide, 4D seismic applications have increased substantially; however, as seismic is a recent technology, there are relatively few processes available to evaluate it[34].

In 2004, BP in Trinidad and Tobago faced the challenge of valuing a number of seismic survey options over the Greater Cassia Complex in the Columbus Basin, Trinidad. In Southern Greater Cassia, several trillion cubic feet (tcf) of gas reserves are located under shallow gas reservoirs, which often blur seismic visualisation. Development of these reserves is complicated by the presence of 27 stacked reservoirs with reserves trapped in over 100 separate segments[35].

BP had to identify and value the style of survey required to improve seismic visualisation over the southern half of the complex, which was affected by shallow gas imaging problems, and value the benefits that 4D seismic could offer for reservoir management and future well placement. This required consideration of expensive 4D Ocean Bottom Cable (OBC) seismic acquisition options. Additional benefits from 4D seismic for monitoring dynamic reservoir performance could be foreseen with a permanent installation. Here BP developed several research programmes to ascertain which 4D acquisition option was the best solution. The integration of these results, along with other elements, helped support decisions for a seismic strategy for the 'Life of the Cassia Complex'[36].

Mature Field Seismic Application in Petrobras' Deepwater Campos Basin, Brazil

Petrobras acquired its first 4D seismic in the Marlim field in 1997. In 1999, Petrobras started several 3D, reservoir-oriented seismic acquisition programmes covering former 3D surveys. These occurred in the South Marlim, Barracuda and Caratinga, Espadarte, Marimbá, and Pampo-Linguado fields in the Campos Basin.

Common seismic processing techniques were used to map reservoir turbidite systems and to reduce appraisal and production risk. Visualisation techniques were applied in 3D views of exploration and development projects[37]. From its initial evaluation of the 4D interpretation, Petrobras was able to re-locate the trajectories of 11 development wells planned for the Marlim Complex. In addition, the company was able to identify the need for nine additional wells to improve reservoir drainage efficiency. In short, the company realised a Return on Investment (ROI) of more than 40 times by saving US $1.6 billion by not drilling wells in the wrong place. It remains to be seen how much additional revenue the company will gain from drilling its development wells in the right place.

Geosciences

Oil companies commonly apply dual geoscience programmes of seismic for reservoir characterisation and also 3D geological modelling. Seismic for reservoir characterisation is a main issue. An acquisition project was started in 2005 with the objective of acquiring

Figure 2 - Offshore Vessel in the Troll Field

base 4D timelapse data of the whole Marlim Complex (Marlim, Marlim Sul and Marlim Leste fields). Petrobras has a '4D-room' where geologists and engineers can visualise geological phenomena[38,39]. At the time, Marlim was the largest seismic acquisition ever acquired both in terms of area and the amount of data acquired. The data amounted to 157 terabytes and required the continuous application of 12,000 processing units (9000 of which were located in Houston and 3,000 in Gatwick, UK).

Regarding the specific challenges that reservoirs create, modelling reveals such things as key depositional features and reservoir geometry which can help explain the gross size, volumes and channels of the reservoir[40].

Mature Field Application of 3D Seismic and Multilaterals in Norway's Troll Field

The Troll field is located approximately 50 miles (80 km) off the west coast of Norway in shallow seawaters. Troll's reserves are mainly gas (at one time it was considered to be a gas play only), but it also contains sizeable oil reserves and has produced more than one billion barrels of oil.

This oil, however, was distributed in hard-to-reach thin oil-bearing layers that were just 13 ft to 85 ft (4 to 26 m) thick and spread out over an area of approximately 173 square miles (450 sq km)[41,42].

A combination of multi-laterals and state-of-the-art geosteering drilling technology was required to drain the thinly dispersed pockets of oil. This included the latest rotary steerable systems in conjunction with reservoir imaging tools, which allowed the oil company to place the well in the best parts of the reservoir. This, however, was only half the story as state-of-the-art completion and production technology was required due to challenges such as Subsea sand and water separation.

In the late 1980s, it was the belief that the development of Troll oil would 'never' be economically feasible because its oil reserves were so thinly layered and the price of oil was US $10 per barrel; however, with the creative use of technology, Troll became one of the largest oil producing fields in the North Sea. The success of this drilling and production approach led to its application in even thinner oil layers measuring just 23 ft to 46 ft (7 to 14 m) thick[43].

The Troll story is one of realising the potential of the field by: applying modern drilling technology; placing well trajectories within a very difficult and challenging reservoir; and keeping sand and water production to a minimum to achieve maximum production.

These successful field applications illustrate the immense financial and technical risks faced by the oil companies in reaching their prize, and show how challenges can be overcome to realise added profit and extended reservoir life.

We have seen how technology in Extreme E & P and mature field applications has extended Hubbert's peak into a plateau. With the powerful combination of technology and knowledge we are producing from reservoirs once thought to be unproduceable and improving overall recovery rates.

But how does the oil and gas from wells reach consumers?

References

1. Enhanced Oil Recovery, Textbook Vol. 6. by Don W. Green and G. Paul Willhite ISBN: 978-1-55563-077-5, Society of Petroleum Engineers 1998.

2. For details of reservoir gas injection and wellbore artificial lift see Petrobras Technology Harts E & P June 2003.

3. These are general figures and are illustrative only. Significant variations occur in practice.

4. Case Study based on information sourced from SPE papers written by Farid Shecaira, Eduardo Faria and other Petrobras sources.

5. Reservoir Engineering Aspects Of Waterflooding Monograph Vol. 3 ISBN: 978-0-89520-202-4 Society of Petroleum Engineers.

6. Thermal Recovery Monograph Vol. 7 by Michael Prats ISBN: 978-0-89520-314.4 Society of Petroleum Engineers, 1986.

7. Modelling future behaviour covers data entry.

8. Fluid samples will be as representative as possible of the reservoirs.

9. This can be an ongoing process accompanying the lifecycle of the field.

10. Petrobras E & P Technology June 2003 Harts.

> "Due to the increasing number of brown fields worldwide, 4D seismic applications have increased substantially; however, as seismic is a recent technology, there are relatively few processes available to evaluate it."

11. See PRAVAP Petrobras Advanced Oil Recovery Program.

12. Petrobras E & P Technology June 2003 Harts.

13. SPE 65589 Remotely Acidizing Satellite Wells by E. P. Da Motta, C. C. M. Branco, F. S. Shecaira, Petrobras Source SPE International Symposium on Oilfield Chemistry.

14. SPE 69474 Using Tracers to Characterize Petroleum Reservoirs: Application to Carmopolis Field, Brazil by Maria Aparecida de Melo, Carlos Roberto de Holleben, Alcino Resende Almeida, Petrobras R & D Centre.

15. Variations on hydrophilic gel include mechanical inflow control devices with hydrophilic membranes.

16. Both from a light oil and carbonate reservoir perspective.

17. Petrobras presentation on development strategy.

18. Tight gas reservoirs have become a major front in the US and Canada.

19. See Petrobras PRAVAP.

20. SPE 112160 The Fazenda Alegre Journey into Intelligent Energy—Lessons Learned From a Successful Holistic Approach of People, Process, and Technology Aligned to Business Strategy and Results Author W.L. Vinturini, G.B. de Castro, and J.H.S. Crespo, Petrobras, and J.R. Albernaz, M.A.S. Lopes, and A. Valadares, Accenture.

21. Petrobras E & P Technology Harts June 2003.

22. SPE 94898 Evaluation of Polymer Injection Projects in Brazil. Authors M.A. de Melo, C.R.C. de Holleben, I.P.G. da Silva, A. de Barros Correia, G.A. da Silva, A.J. Rosa, A.G. Lins and J.C. de Lima, Petrobras.

23. Petrobras E & P Technology Harts June 2003.

24. Idem.

25. Reservoir Engineering Aspects Of Waterflooding Monograph Vol. 3 ISBN: 978-0-89520-202-4 Society of Petroleum Engineers.

26. See Pravap.

27. Petrobras E & P Technology Harts June 2003.

28. Idem.

29. Reinjection is the ideal solution.

> "These successful field applications illustrate the immense financial and technical risks faced by the oil companies in reaching their prize, and show how challenges can be overcome to realise added profit and extended reservoir life"

30. This is the Life of Complex Seismic (LoCS).

31. Value of Information for a 4D-Seismic Acquisition Project by P.R. Ballin, SPE, G.S. Ward, C.V. Whorlow, and T. Khan, BP Trinidad and Tobago LLC Source SPE Latin American and Caribbean Petroleum Engineering Conference, 20-23 June 2005, Rio de Janeiro, Brazil.

32. SPE 99948 Integrated Multizone Low-Cost Intelligent Completion for Mature Fields H.L. da C.P. Pinto, M.F. Silva Jr., R.G. Izetti, and G.B. Guimarães, Petrobras.

33. SPE 94705 Produced Water Reinjection in Petrobras Fields: Challenges and Perspectives Author C.J.A. Furtado, A.G. Siqueira, A.L.S. Souza, A.C.F. Correa, and R.A. Mendes, Petrobras.

34. SPE 104034 New Life for a Mature Oil Province via a Massive Infill Drilling Program J.G. Flores, SPE, and W. Gaviria, SPE, Schlumberger, and J. Lorenzon, SPE, J.L. Alvarez, and A. Presser, Petrobras Energia S.A.

35. Petrobras EP Technology Supplement Brazil Oil and Gas Issue 7.

36. Idem.

37. Petrobras EP Technology Supplement Brazil Oil and Gas Issue 7 Seismic throws up array of applications.

38. Most oil companies have similar seismic visualisation rooms.

39. At the time Marlim was the largest acquisition.

40. The models are corrected and validated with field data.

41. Cost Effective Horizontal Drilling in the Troll Field Through use of State of the Art Technology and Optimal Operations by Henriksen, N., Storegjerde, D., Norsk Hydro A/S SPE/IADC 1997.

42. Idem.

43. Troll West Oilfield Development—How a Giant Gas Field Became the Largest Oil Field in the NCS through Innovative Field and Technology Development by Richard Dyve Jones, StatoilHydro AS, Erland Saeverhagen, Arve K. Thorsen, and Sveinung Gard, SPE, INTEQ IADC/SPE 2008.

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