Workshops Yesterday, Today, and Tomorrow

As of October 1, PTTC began a new year of work with Department of Energy’s National Energy Technology Laboratory (NETL), its twenty-first contract year of collaboration. With this new fiscal year, PTTC will direct its focus toward ramping-up its national workshop schedule, targeting areas around the country that are currently not as well served. See our regional and national schedule on Page 2, and look for us to add to the schedule as the year’s plans take shape. PTTC’s quality technology workshops will be highlighted on March 17th at the ASME Energy Forum in San Diego (Page 5), bringing three of PTTC’s regional directors together to host the day’s events.

With more workshops to come, PTTC is making registration and information dissemination easier for our users. You should have received a PTTC email in November allowing you to register for PTTC Access (https://netforum.avectra.com/eWeb/Start-Page.aspx?Site=PTTC). If you haven’t had a chance to do it, click now and you will be able to update your subscription profile and register for new PTTC events! There will be additional benefits down the road as we continue to enhance our system.

PTTC Access…
New System is Online!

to Login

Independent’s Focus

Independent operators have been the backbone of the oil and gas industry in the U.S. for decades. The recent explosion of shale gas and oil plays has greatly expanded the scope and size of many independent companies. Oil and gas activity has created a niche for smaller companies and independent operators working in mature fields across the country. Economical operation is the key to success. New technologies and strategies that provide low-cost, effective solutions for drilling, completions, improved simulation and monitoring software, waste disposal, and environmental compliance can improve the economic situation for all companies, regardless of size or region. PTTC’s mission has been to supply this information to independents through workshop, Tech Alerts and publications.

The Utica Shale in Ohio has Chesapeake, Gulfport and Shell as the main operators, but there is opportunity for a number of other players. The number of well permits and drilling indicates that the Utica is still very much in the exploration and delineation phase of development. The gradient across the Utica shows the liquid rich areas experiencing the greatest activity. However, exploration into wet gas areas covers the eastern half of Ohio and has expanded into western Pennsylvania.

The Rocky Mountain region describes how new emissions regulations in Colorado will impact operators and demonstrates that operators working with regulatory agencies can help craft “rules as a way to operate more safely and build public trust.”

Workshops and seminars in several regions should appeal to independent operators. The West Coast will continue to focus on operational workshops to update technical skills and improve understanding of drilling and completion practices. In the Midwest, PTTC is teaming with the Illinois Oil and Gas Association for three days of workshops and meetings that will address Mississippian age drilling targets in the Illinois Basin.

The Midcontinent PTTC is proud to announce support for the new Joint...
PTTC is a sponsor of the American Society of Mechanical Engineers (ASME) annual convention to be held in San Diego, CA in March 2014. PTTC will conduct four workshops on topics to assist independent operators.

PTTC headquarters is holding a workshop in Dallas on February 19 with an array of speakers provided by Drilling Info. Drilling Info is a leading provider of software for intelligent operation of oil and gas operations. Drilling Info has been a staunch supporter or PTTC efforts to present critical information to the oil and gas industry to expand exploration success and improve economics of development and operation.

At the request of oil companies in Tulsa, OK, PTTC headquarters is organizing a training session on how to use FracFocus 2.0 in early February. FracFocus was developed by the Groundwater Protection Council and will be required as a registry for chemical use in hydraulic fracturing operations in many states starting in January 2014.

PTTC’s has been involved with a Carbon Capture and Storage project that ended in September, 2014. A great deal of information has been assembled related to CCUS and particularly CO2 EOR which has proved to be the most feasible CCUS option. PTTC is redesigning the CCUS website and it will be unveiled early in 2014. Look for some exciting videos on Residual Oil Zones and interviews on CO2 flooding operations on the new website. A review of the recent successful 19th Annual CO2 conference highlights a field trip to SACHEM.

The National Energy Technology Laboratory newsletter, E&P Focus for the fall 2013 edition addressed a number of technologies geared at helping independent operators. A desalination project in New Mexico provides a novel, low-cost, on-site method for separation of produced water that is applicable for arid conditions and small, mature field operations. In a more futuristic mode the U.S. Department of Energy announced funding for seven new methane hydrate research projects. Both of these stories focus on DOE mission to fund high risk research to support increased energy security for the U.S.
Is the oil and natural gas industry on the cusp of another step-change in resource development as unconventional oil and gas plays mature?

What’s the potential EUR for Bakken, Eagle Ford, and other shale wells?

What are the best EOR processes to deploy in the vast emerging shale and tight sands plays?

How will reservoirs subjected to huge multi-stage frac jobs respond to tertiary recovery methods?

What are the prospects for CO₂ EOR with carbon sequestration in unconventional plays?

How can water treating/handling best practices developed for EOR projects transfer to these new unconventional resource developments?

Get answers to these questions and learn even more about all the cutting-edge IOR and EOR technologies at the 19th Improved Oil Recovery Symposium, April 12-16, 2014, in Tulsa, Okla. Sponsored by the Mid-Continent Section of SPE since 1978, this biennial conference of the world’s leading experts in improved oil recovery and enhanced oil recovery is the largest gathering of its kind anywhere in the world.

**IOR 2014 HIGHLIGHTS**

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<td>EOR/IOR for Unconventional Reservoirs</td>
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<td>Water Treating for Shales, Tight Sands</td>
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<td>Miscible/Immiscible Gas Flooding</td>
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<td>Chemical Flooding</td>
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<td>Novel EOR/IOR Technologies</td>
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Join us at the 19th IOR Symposium in Tulsa on April 12–16, 2014, to learn about the latest advances and best practices and network with the top experts in IOR and EOR technology.

**EXPLORE THE POSSIBILITIES AT IOR 2014:**

Register Now at www.speior.org/registration.asp
The West Coast PTTC program is actively coordinating 16 workshops for 2014, with additional ones scheduled as topics and instructors are established. The program is administered by Jerry Anderson, the West Coast PTTC director and Chair of PTTC, and Dan Tuttle the training coordinator. Full day workshops are held throughout California in locations as Sacramento, Bakersfield, Ventura and Long Beach. The programs are well attended with individuals from oil and gas companies, regulatory agencies, consultants, and service providers.

PETROLEUM GEOLOGY FOR THE NON-GEOLIGIST will be held January 28 in Long Beach, January 30 in Bakersfield, and March 17 in San Diego in partnership with the ASME Energy Forum. This course is designed to help non-geologists in petroleum-related fields understand just what all these geologists are talking about! It will discuss why oil is found in some areas and not in others, what kinds of tools geologists use to assess the petroleum potential and petroleum reserves in an area and what factors they consider when deciding where to drill. During the class, you will work as part of a team of “geologists” that will come up with several “prospects” for drilling.

CEMENTING 101 will be held February 25 in Long Beach and February 27 in Bakersfield. Primary and remedial cementing operations are important in both drilling and production well work. This course is intended for individuals with little to no prior cementing knowledge who will benefit from learning more about the cementing process. Cementing objectives, properties, testing, additives, equipment, and best practice procedures will be discussed for various types of cementing jobs. Cement calculations will be made to determine the proper design and volumes appropriate for well work. Finally, a case history will be reviewed and cement evaluation tools will be discussed.

FUNDAMENTALS OF WELL COMPLETIONS will be held in April 1 in Long Beach and April 3 in Bakersfield. In petroleum production, completion is the process of making a well ready for production. Understanding the completions process is important for many non-technical professionals working within the oil and gas industry. This course is intended for individuals with little to no prior completions knowledge who will benefit from learning more about the completions process. Different types of completion design will be covered, including open-hole, perforated, gravel packed, fractured, and more. Attendees will leave the course with a basic understanding of wellbore and completion equipment and methods. The course will also address topics such as completion fluids, stimulation, and testing methods.

Other workshops being developed for 2014 include Designing and Operating Waterfloods, Drilling Engineering, BOPE Operations Thermal Operations, and Casing Design.

As we move forward in our planning for future workshops, we are utilizing suggestions to schedule workshops and providing quality instruction to the petroleum industry and related agencies.

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Methane Hydrate Research

On November 20, 2013, DOE Secretary Ernest Moniz announced seven awards totaling nearly $5 million to further research and understanding on methane hydrates. The announcement noted that methane hydrates are a “large, completely untapped natural gas resource” that can potentially improve our “environment, as well as American economic competitiveness and energy security.” The awards went to:

**Georgia Tech Research Corporation (Atlanta, GA)** — to develop a new borehole sampling tool for direct, in-place measurements of methane hydrate deposits.

**The University of Texas at Austin (Austin, TX)** — with Ohio State University and Columbia University-Lamont Doherty Earth Observatory to develop 3-D reservoir models of methane hydrate properties.

**Texas A&M Engineering Experiment Station (TEES) (College Station, TX)** — TEES, in conjunction with the Georgia Institute of Technology, will develop a numerical model to address the many complexities associated with production from hydrate-bearing sediments.

**Oregon State University (Corvallis, OR)** — Oregon State University, in conjunction the Universities of Bremen (Germany) and Tromso (Norway), will assess the response of methane hydrates to environmental changes at the Svalbard continental margin, part of Norway’s continental shelf.

**Massachusetts Institute of Technology (MIT) (Cambridge, MA)** — will study sea-floor conditions conductive for development of natural gas hydrates in the Gas Hydrate Stability Zone (GHSZ).

**University of Washington (Seattle, WA)** — will study the effects of contemporary warming of bottom water temperatures on gas hydrate stability along the Washington Margin—the boundary between two continental plates.

**University of Oregon (Portland, OR)** — will develop predictive models to enhance our understanding of how hydrates develop, and the environmental forces that cause them to dissociate.
PTTC WORKSHOPS/ 2014 ASME ENERGY FORUM
SHALE DEVELOPMENT AND HYDRAULIC FRACTURING
MARCH 17-19, 2014
SAN DIEGO CONVENTION CENTER

The Petroleum Technology Transfer Council (PTTC) will be providing a series of workshops in Partnership with the 2014 ASME Energy Forum Live: Shale Development and Hydraulic Fracturing. The PTTC workshops will be held the morning of March 17 and will consist of four (4) one half day workshops with an excellent range of topics. Registration and information on PTTC workshops and the 2014 ASME Energy Forum can be found on the ASME website.

PTTC Workshops March 17
- Petroleum Geology for Non Geologists
- Methodology and Approaches for Drilling, Evaluation, Fracturing, and Completions in Unconventional Shale Resources
- Wellbore Integrity Throughout Its Life Cycle
- Rock Mechanics for Fracturing Applications

March 17-19 ASME Energy Forum Live – Oil & Gas
In its debut year, ASME Energy Forum Live – Oil & Gas will focus on shale development and hydraulic fracturing for recovering natural gas and oil. Shale gas is projected to increase to 49% of U.S. gas production by 2035, up from 23% in 2010 – shale gas has already led the U.S. to become the world’s leading natural-gas producer.

The progression of safe, consistent and reliable shale development depends, in large part, on engineering prowess. ASME Energy Forum Live – Oil & Gas will bring together industry leaders in a conversation on technologies, applications, and solutions required for competing in this global marketplace. In particular, we will offer long-sought focus on the suppliers of hardware/equipment/function systems for both surface and subsurface facilities. The result will be a high-level, three-day conference program that highlights critical challenges and opportunities associated with shale exploration, development, and production.

Program topics include:
- Taking Advantage of the Global Shale Revolution
- Enabling Technology: Hydraulic Fracturing
- Technological Excellence for Optimal Effectiveness and Efficiency
- Technologies for Completion and Fracturing
- Achieving Sustainable and Profitable Production
- Production Enhancement: Artificial Lift and Re-Fracturing
- Environmentally Sustainable & Competitive Solutions
- Technologies for Drilling and Completion
- Opportunities, Strategies, and Economics for Entering Shale Play Market
- Water Management in Shale Plays
- Shale Play Summaries, Trends and Case Histories
Rocky Mountain Region

Colorado Operators and State Officials work together to set New Emissions Standards by Mike Seal

Under proposed new rules announced by Gov. John Hickenlooper (D) on November 18th, Colorado would become the first state to monitor and regulate methane emissions associated with oil and gas drilling. These regulations were formulated with the cooperation of both oil and gas companies and environmental groups, and could be effective by February of 2014.

The new rules will require oil and gas drilling companies to monitor tanks, pipelines, wells and compressor stations for leaks, and report monthly on methane emissions. The state also plans to include new limits on emissions from dehydrator units near residential areas. Companies would be required to use flare devices to burn off emissions from facilities not connected to pipelines. Current federal standards only require leak detection at natural gas processing plants.

Anadarko Petroleum, Encana Corporation and Noble Energy are the three big companies that negotiated and support these regulations. Korby Thorben, Anadarko’s Director of Heath and Safety in the Rockies, is quoted in the Wall Street Journal as saying “throughout the development of oil and gas resources, industry is taking the steps necessary to protect human health and the environment”. Noble Vice President Ted Brown, quoted in the Denver Post, said the prescribed practices are “the right thing to do” but added that “it’s a tough rule.” He and counterparts from Anadarko and Encana said they support the proposed rules as a way to operate more safely and build public trust.

The Air Quality Control Commission at the Colorado Department of Public Health and Environment (CDPHE) will administer these regulations. The CDPHE negotiated the new rules with the Environmental Defense Fund and the three companies. The CDPHE estimates they will reduce volatile organic compound emissions by about 92,000 tons a year or 34%, an amount greater than the emissions from vehicles in Colorado. Fred Krupp, president of the Environmental Defense Fund, called the rule-making process a “model for the nation. It shows that state officials, industry leaders and environmental groups can come together to develop win-win solutions that help square the need to protect local communities and the environment with the need for domestic energy production.” A CDPHE study estimates the cost to operators for monthly inspections for leaks to be $30 million per year. Formal public hearings to finalize these regulations will be held in February 2014.

It is hoped that these rules could help bring Colorado’s heavily populated Front Range, where air pollution is on the rise, back into compliance with federal air quality standards. According to the Colorado Oil and Gas Commission (COGCC), the state produced more than 40 million barrels of oil in 2012, the first time since 1962 Colorado has reached this level. This increase is largely due to successful drilling in the Niobrara Formation on the Front Range. However, as population increases and housing developments are built further from Denver and other cities, people are coming into more contact with oil and gas operations that were largely accepted by the previous rural inhabitants, who were more likely to hold the mineral rights to their property.

Midcontinent Region

KU TORP Unveils Joint Industry Project

Recently longtime PTTC supporter and midcontinent regional lead organization, the University of Kansas Tertiary Oil Recovery Program (KUTORP) unveiled its joint industry project (JIP) aimed at helping operators working in unconventional reservoirs. “Sustainable Hydrocarbon Recovery in Unconventional Reservoirs” focuses on four main thrust areas. Produced Water Treatment; Hydraulic Fracturing in Shale Formations; Enhanced Oil Recovery in Shale Formations; Reservoir Characterization and Simulation

Thrust Area 1, “Produced Water Treatment,” looks at the removal of naturally occurring radioactive materials (NORMs) and scale-causing minerals using polyelectrolyte complexes as nanoized entrapment agents forming around target metals, such as barium, strontium, and radium, directly in the produced water. Once formed, these nanoparticles can be separated from the produced water through filtration or gravity separation, and possibly regenerated for additional use.

Thrust area 1 also looks at the application of fluidized bed biological reactors for the removal of organics to speed up the reaction rate, and provide the ability to process large volumes in less space.

Thrust Area 2, “Hydraulic Fracturing in Shale Formations,” is focused on the development and use of nano-proppants for hydraulic fracturing of shale formations – specifically the development and use of nano-proppants capable of packing micro-fractures to prevent fluid loss and improve both effective fracture length and productivity of the fractured wells.

Additionally, thrust area 2 will look at how nanoparticle-stabilized CO₂ foam can be used as a fracturing fluid and how the combination of different nanoparticles and chemicals can be used to optimize the performance of such fluids.
Midwest Region

Midwest PTTC is planning an Illinois Basin Middle Mississippian Targets Workshop to be held March 5, 2014 in Evansville, Indiana. This will be held the day prior to the annual Illinois Oil and Gas Association meeting. The day-long workshop will include presentations from industry, service companies, and the Basin’s Geological Survey scientists. Middle Mississippian rocks in the Illinois Basin are host to carbonate, chert, cherty limestone and silty sandstone reservoirs, with complex reservoir architecture of inter-fingering facies and formation relationships. These rocks are the focus of recent successful vertical hydraulic fracturing efforts; for example, with Citation’s multiple-zone hydraulic fracturing and re-fracturing program in thin, low-porosity zones in the Griffin bottoms area in SW Indiana spurring competitive leasing and development in the area by many companies. Rex Energy recently added horizontal wells to the strategy, and has conducted possibly the highest-volume hydraulic fracture stimulation in the basin to date. This workshop will strive to bring registrants up-to-date with new considerations of at an important series of reservoir rocks.

Thrust Area 2 will also look into the effects of produced water composition on fracturing fluid efficacies, Specifically identifying the levels below which chemical contaminants need to be reduced in order for reuse to be attractive to the producer.

Finally thrust area 2 will be looking at an improved fracture propagation model, developing robust models capable of modeling fracture propagation in a variety of lithofacies, including in brittle or semi-brittle formations with natural fractures.

Thrust Area 3, “Enhanced Oil Recovery in Shale Formations” looks at the possibility of gas injection to enhance oil recovery from shale formations, specifically the feasibility of using different gases to improve oil recovery in tight shale formations. Working in collaboration with the DOE Idaho National Lab, a geocentrifuge will be used as a “time machine” to model the recovery process by accelerating the gas invasion into tight shale rock. Initial focus will be on CO2 due to its ability to reduce the oil viscosity through dissolution and extraction. Other gases will be evaluated later.

Thrust Area 4, “Reservoir Characterization and Simulation,” will be looking at the development of improved reservoir characterization models using improved correlations between seismic data and fracture properties to develop a more representative fracture network/property model for shale reservoirs capable of adjusting the fracture spacing based on the fracture characteristics of the reservoir.

Also thrust area 4 will look at the development of a small scale model for production from a naturally fissured shale block that captures the full physics behind the shale gas or oil production. This model will then be extended to reservoir scale models.

The project’s duration will be three years and is anticipated to kickoff July 1, 2014. Annual membership for companies begins at $70,000

If you would like more information about how you can become a part of the KU TORP Joint Industry Project please contact Jenn-Tai Liang at jtiang@ku.edu

For 20 years now, PTTC’s successes reside in meeting the industry’s needs for information on petroleum geology and technology. We maintain information resources that may help in unlocking potential analogs to other hot plays…following important advances in technology…places for making connections that may be helpful to you.
Eastern Region

Utica-Point Pleasant Shale Play Continues to Show Promise

Nearly 1,150 permits have been issued to drill wells to the Upper Ordovician Utica-Point Pleasant Shale, mainly in Ohio, but with approximately 200 in western Pennsylvania and four in the northern panhandle counties of West Virginia. Although operators for more than 500 of these permitted wells have yet to begin drilling, approximately 200 wells have been drilled and are producing, and another 400 are currently drilling or have been drilled but are not on line. Only 13 wells have been plugged and abandoned (P&A).

Drilling has extended the Utica-Point Pleasant play from the core area in Carroll, Harrison and Columbiana counties, OH to Tioga County, PA on the east; Washington County, OH on the south; Licking County, OH on the west; and Ashtabula County, OH on the north. The current trend in drilling reflects the subsurface structure of the shale – a north-south trend in Ohio, swinging to northeast-southwest on the north and then to east-west in Pennsylvania.

Chesapeake is by far the biggest player in the trend, with Gulfport and Shell a distant second and third. Chesapeake has received permits to drill 588 wells (51% of all permits issued), of which 122 are producing or completed and only 4 have been plugged. Other companies in the play have been issued an additional 561 Utica permits, resulting in 76 producing wells and only 9 dry holes; 318 have yet to be drilled, with the remaining still being drilled or awaiting completion.

As industry extended the infrastructure, production was able to increase. Second quarter 2013 production reported by Chesapeake was 85 MMcfe/d from 106 producing wells. Estimated ultimate recoveries (EURs) are in the 5-10 Bcfe range in the wet gas area. Chesapeake has concentrated in the core area, but has drilled wells to the east in Beaver County, PA and as far north as Portage County, OH.

Gulfport has been issued 86 permits to drill, mainly in Harrison and Belmont counties, OH, and has 18 producing wells. Their wells in the liquid rich area have an average horizontal length of 7,175 feet, with 25 frac stages, and an average IP of 2,780 BOE/d. Of this total, 33% is oil, 37% is gas, 29% is NGL, and 19% is shrinkage. One well, the Shugert 1-12h, is in the dry gas window and tested 30.3 MMcfg per day.

Shell has concentrated their effort in the dry gas area in Pennsylvania from Lawrence County to Tioga County. They have received 71 permits, and have drilled 4 producing wells to date.

Antero has received 47 permits to drill wells on their 101,000 acres in Monroe and Noble counties, OH. All but 16 have been drilled, with 11 producers and 2 dry holes reported to date. Seven of their producing wells, however, are among the top 10 producing wells in Ohio, averaging 5,632 BOE/day (19.4 MMcf/d), with the best well testing 8,879 BOE/day (38.9 MMcf) on a 24 hour test. All of the wells have produced gas, condensate and NGLs; 57% of the production is liquids.

Magnum Hunter has called the Utica potentially the best shale play in the US, and sold their acreage in the Eagle Ford play to concentrate on the Utica-Pt. Pleasant. They drilled the first horizontal well in Washington County, OH in April, 2013 on the Farley pad, designed to accommodate 10 horizontal wells, all with a NW-SE orientation. Their Stalder pad, in Monroe County, OH has been designed for 18 horizontal wells, 10 for the Marcellus Shale and 8 to the deeper Utica Shale. There also could be Rhinestreet Shale potential in this area that could be tested in the vertical section of the pilot well.

To further underscore the potential of this play, in 2011, 9 Utica wells produced 1% of the oil and 3.5% of the gas produced in Ohio; in 2012, 87 Utica wells yielded 12% of the oil and 16% of the gas produced in Ohio; and by 2015, an estimated 1000 wells could produce 73% of the oil and 82% of the gas in Ohio.

Note: This information was provided by Ron Riley, Ohio Geological Survey. Additional information was obtained from the Pennsylvania Geological Survey.
Low Temperature Desalination

Disposal of highly saline produced water is an expensive issue for field operators, particularly for smaller operations in mature fields in the Rocky Mountains, where salinity may be nearly six times higher than salt water. New Mexico Institute of Mining and Technology working with Harvard Petroleum Corporation and Robert L. Bayless, Producer, LLC recently completed laboratory and field tests for low temperature distillation humidification dehumidification (HDH) process for on-site removal of salts from produced water. Funding for the research was provided by the U.S. Department Energy through RPSEA (Research Partnership to Secure Energy for America).

Past desalination projects have focused on reverse osmosis, distillation, electrodialysis, freeze-thaw and ion exchange methods all of which have different limitations related to economics and climate. The low temperature desalination process was developed for arid climates, such as found in much of the southern Rocky Mountains and Western U.S.

The HDH process “relies on the mechanism of air humidification at elevated temperatures and water condensation at low temperature.” The concept addresses the fact that air holds large amounts of water vapor at high temperature, but when the temperature is reduced the vapor will condense. By passing the water vapor through a series of baffles the condensed water is separated into pure water for reuse and a greatly reduced waste stream for disposal. The goal of the research project was to develop a low-cost, on-site treatment option, applicable to remote, mature fields in the arid southwest U.S.

During Phase I of the project bench-scale units were developed and tested. The testing used produced water from a coalbed methane well. The HDH system was able to effectively reduce salts and organics; total dissolved solids from 19,800 to 77 mg/L and reduced total organic carbon from 470.2 mg/L to 17.83 mg/L.

In Phase II the capacity of the HDH system was increased to treat 30 bpd of water. The process works best when the water is recycled through the system. In the first past 18-20% of produced water was cleaned. Several iterations of the design optimized the performance produced 99% pure water. Design elements added during Phase II included; addition of an oil skimmer to separate oil from produced water prior to treatment, flat plate solar collectors to provide energy in the field for the steam generation unit, stainless steel chambers with cellulose based packing materials to “maximize contact time between air and water” in the process, and a cold trap to condense and collect the purified water. A schematic of the design is shown in Figure 1.

Field tests conducted in New Mexico were run for 8 hours at a time to process 20 bbl of produced water. The solar panel was sized to produce heat sufficient to maintain a 24-hr cycle of operation even in winter months using a storage tank of heated water for overcast days and night operations. The HDH system contained in its on-site shipping unit with the water storage tank in the foreground is shown in Figure 2.

Large-scale water purification technologies using reverse osmosis and membrane filters range in cost from $0.70 to $1.25 per barrel when large volumes of water are treated. For small operations and remote locations where transportation and energy use becomes an issue these large-scale technologies would be higher and are not cost-effective. The HDH system is designed to operate on 20Bpd capacity systems for a cost of $0.45 to $0.80 per barrel. The HDH system is designed to be most efficient in relative humidity conditions below 60-70%, such as the arid southwest. This makes the HDH system a feasible water treatment system for fields in the San Juan, Paradox and Permian basins, and would also be applicable in the Great Plains.

CO₂ Week in Midland, Texas – December 9 – 13, 2013

CO₂ Week in Midland consisted of the 11th Annual Carbon Management Workshop and the 19th Annual CO₂ Flooding Conference, sandwiching in a Wednesday field trip to SACROOC and a daylong short course on surveillance and monitoring of CO₂ Injection Projects – a key issue in the transition of an EOR project into a long term sequestration project, should that ever become attractive or required.

The EOR Carbon Management Workshop portion of the week kicked off Monday afternoon with a CCUS Policy and Regulatory Forum convened by the Global CCS Institute. The main themes of both the Monday session and the Workshop program on Tuesday were policy and regulatory, both of the UIC Class VI issues and Greenhouse Gas Reporting; resource assessment; the monitoring and accounting for carbon in EOR projects; and new CCUS projects and technology.

The on-going issues with EPA regulatory activities in the CCS space were voiced by environmentalists, state regulators, CO₂ EOR operators, fossil fuel power plants and other large GHG emitters. One of the speakers on Monday, Kevin Connors of the North Dakota Industrial Commission, described the progress North Dakota has made in crafting state regulations, including ownership of the pore space and the conflict created by the finalizing of the UIC Class VI permitting rules. His commission has been working diligently to negotiate with the EPA to be granted State primacy to issue those Class VI permits; he offered that they have made some progress in the two years working on it, but they have not reached the finish line. Thus far, no State has been issued primacy for Class VI (most oil/gas producing states have primacy for Class II injection wells). Nor have any permits been issued by EPA, although several have been pending for over a year.

Scott Deatherage, a partner in Gardere Wynne, Sewell LLP discussed the ongoing feud between the State of Texas and the EPA regarding permits for large GHG emitters, both new and upgraded. Texas has disagreed with a number of new requirements including the “Tailoring Rule” which defines the threshold as to how much emissions trigger a review and will require emitters to consider CCUS as Best Available Control Technology in seeking the air permit. EPA responded by taking away primacy from Texas to issue such permits, but has not staffed up to review them themselves. There is also apparently a disagreement between the districts and Washington regarding the review. Both insist that CCUS is a technology that must be considered, but the districts have found it to be too expensive, while Washington does not.

On the brighter side, a number of speakers spoke of on-going and future increases in the sourcing of new CO₂, mostly anthropogenic, including gas processing plants, and new EOR projects in the Rockies, Gulf Coast, Permian (Basin) and Midcontinent areas. The keynote speaker on Tuesday, Vello Kuuskraa of Advanced Resources International shared the results of their expanded basin assessments of EOR potential to add the Residual Oil Zone (ROZ) and offshore potential. Figure 1 summarizes that assessment, essentially doubling the CO₂ available for project development by 2020. The ARI forecast was echoed and reinforced by a paper in the Flooding Conference by Glen Murrell of EORI and Phil DiPietro of NETL. Their forecast showed new supplies in all the existing areas coming from industrial, gas processing and new and expanded natural domes, reaching the 6 BCF/day level by 2018, with corresponding increases in oil production. These presentations and all others can be found at www.co2conference.net after December 25, 2013.

A number of papers were presented in the Theme Sessions Thursday and Friday about new unconventional sources for CO₂. In addition to the previous work by ARI and Melzer Consulting on ROZ potential in the Permian and Williston basins and elsewhere in the U.S., the results of two European studies were presented. Tom Haselton, of Odin Energy described the potential for CO₂ EOR...
out of the residual oil zone in a concession held by Odin in Lithuania. Van Pham, of the Norwegian Petroleum Directorate, presented the results of an investigation and simulation of the CO₂ flood in a ROZ offshore Norway. ROZ development in Europe is currently problematical as there are no naturally occurring CO₂ sources. Chris Cordaro, of Hess, a leader in the development of the ROZ at their Seminole Unit (Permian Basin) discussed their work to overcome the challenges with the concurrent development of their Main Pay Zone and ROZ.

For the first time, the Theme Sessions at the Conference addressed the on-going work to examine the potential of CO₂ EOR in the liquid rich unconventional resources (shales), where the primary recovery is expected to be in the 3 to 6 percent range, leaving an enormous unrecovered oil resource. Two researchers, David Schecter of Texas A&M, and Jim Sorensen showed results from lab analysis of CO₂ applied to Texas and North Dakota shales, respectively. Neither could penetrate the cores with CO₂, but both had measurable success by what were termed diffusion / imbibition processes when moving CO₂ past the cores.

The topic of Surveillance and Monitoring of CO₂ injection projects has increased in importance with the issuing of the final rules for permitting Class VI wells (currently required for saline sequestration, but not EOR). A large part of the difference between Class II Injection and Class VI is the degree of monitoring required. Class VI does not specify specific technologies, but does specify what it must accomplish. Should an EOR operator elect to switch to a Class VI project or at some point in time be compelled to switch, additional monitoring beyond what is done today and verification of storage would play a large role. The Wednesday workshop was dedicated to the legal and technical elements of this topic and can be purchased at the website above. Several speakers addressed monitoring in the Monday Carbon Management Forum. Sean McCoy of the International Energy Agency (EIA) discussed the European view of accounting for CO₂ in the reservoir of an EOR project (of which they have none). While it is known what is injected and what is produced, it is problematical to document what has remained in the reservoir, not leaked into other formations or the air. That makes it difficult to receive carbon offsets or credits.

The field trip to SACROC, the oldest and largest CO₂ EOR project in the world, was well attended and very informative, thanks to the Kinder Morgan hosts. A briefing of the history of the field and a tour of the field and processing plant was provided for the 80 attendees, including those from GE Energy, a new major sponsor of the conference (shown in Figure 2). GE Energy recently announced the development of a new $110 million, 95,000 square feet Oil and Gas Technology Center to open in 2015 to develop a number of technologies including Enhanced Oil Recovery. Mike Ming has been recruited to be the General Manager of the research center.

Several new projects and businesses were presented as well as updates on projects in progress. Chris Tynan, Director of Summit Energy provided an update on their Texas Clean Energy Project in Penwell, Texas proclaiming it to be very close to financial close and groundbreaking. John Palamara of Air Products introduced their recently completed carbon capture project on their hydrogen plant in Port Arthur, Texas. Through September, 2013 it has delivered 500 thousand tons of CO₂ into Denbury’s Green Line. He also outlined a new Helium capture plant at the Doe Canyon CO₂ Source field in southwestern Colorado. Tracy Evans, of Tabula Rasa, described their brief corporate history (formed in 2010), acquisition of two producing CO₂ EOR projects and a CO₂ source field and their business model going forward. The Tuesday Keynote Speaker, Pieter Kapteijn, Maersk Oil (Danish) discussed their plans to utilize turbine technology developed by Clean Energy Systems and Siemens that will consume low-quality, stranded natural gas and produce power, CO₂ and water.

Bruce Howard of Trinity EOR, LLC gave an interesting presentation on the new life of the Wellman Field in Terry County, Texas. It was discovered in 1950, unitized in 1978, and after several operators, given up for dead in 2005 as the CO₂-oil contact was lowered to the oil-water contact. Trinity
assumed ownership and by managing the water withdrawal, CO$_2$ injection and well depths it is now producing 2,300 barrels/day. A similar success story was told by Steve Pennell of Kinder Morgan on the innovative design of CO$_2$ injection in a particularly thick and problematic portion of the SACROC unit in Scurry County, Texas. SACROC was discovered in 1948. After waterflooding and CO$_2$ injection, oil production peaked at 215,000 barrels/day in 1974. (See Figure 3). When Kinder Morgan acquired the unit, production had declined to 8,000 – 9,000 barrels/day. With rigorous pattern development and increased CO$_2$ injection, production has risen and held in the 30,000 barrel/day range. Future development plans include (1) exploitation of the transition zone below the oil/water contact (ROZ), (2) redevelopment of bypassed oil with new horizontal injectors, (3) edge pattern development in areas thought to have 500 million barrels in place, and (4) continuation of the conformance control measures and CO$_2$ injection strategies in the north platform area.

The high point of the week highlighted the ultimate in geological exploration. Dr. Rebecca Williams of the Planetary Research Institute presented a stunning array of pictures with a description of the Findings From the Martian Rover Exploration Mission. The photography was amazingly clear and many of the views from the rover were just days old.

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Training Videos and Interviews with CO$_2$ and ROZ Experts

Interviews and videos will be posted on the APTA (http://training.aptapb.org/videos) and CCUS (www.permianbasinccs.org) websites.

- Interview 1: Introduction to Flooding in the Residual Oil Zone - With Steve Melzer (APTA)
- Interview 2: The size of the ROZ prize - with Vello Kuuskraa (ARI)
- Interview 3: An overview of the Residual Oil Zone - with Steve Melzer (APTA)
- Interview 4: Residual Oil Zones in the Rocky Mountains - with David Mohrbacher (U. Wyoming)

Steve Melzer documented the three types of ROZs we have found as we study reservoirs throughout the world. The following animations provide the introduction to the origins or these ROZ types. Residual Oil Zone Types 1, 2 and 3.

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WORKSHOPS

For information & registration contact vschatzinger@pttc.org

How to use public source data and get the most out of software programs

February 19, 2014 | Farmers Branch, TX

Presented by Drilling Info - an International Oil and Gas Intelligence Company

FracFocus 2.0 Training Seminar

February 2014 | Tulsa, OK

FracFocus - Developed by the Groundwater Protection Council. Instructor: John Veil, Veil Environmental

FracFocus registry will be required in many states in 2014.