Week of Oct. 5, 2009/US$10.00

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Production Technology Update

Human rights lawsuits: mitigating a new threat
Work flow reveals fault complexity
Aramco team plots energy savings at Berri gas plant
SCADA protection requires independent barriers

OIL&GAS JOURNAL®

Oct. 5, 2009
Volume 107.37

PRODUCTION TECHNOLOGY UPDATE

REGULAR FEATURES

COVER

The two pumping units are in Emlichheim oil field in Germany near the Dutch border. Wintershall has been producing the field for more than 60 years, and current production from the field is about 2,800 bo/d. OGJ's special production technology update report, starting on p. 45, includes two articles. The first compares two reverse osmosis processes for treating produced water from Powder River basin coalbed methane wells, and the second continues a series of articles on gas shales that began in OGJ, Sept. 28, 2009. Photo from Wintershall.

General Interest

Exploration & Development

Drilling & Production

Processing

Transportation

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General Interest — Quick Takes

Arbitration move called 'forum shopping'

Lawyers for Ecuadorian plaintiffs in an environmental lawsuit against Chevron Corp. have dismissed the company's filing of an international arbitration claim as "forum shopping" (OGJ Online, Sept. 24, 2009).

Steven Dozinger, a New York lawyer representing the Amazon communities suing Chevron, made the statement while calling the company's move "one of Chevron's last cards to avoid paying for a half-century of environmental contamination in Ecuador's Amazon."

The lawsuit started in 1993, targeting Texaco Petroleum (Texpet), a member of a consortium that had produced oil under a concession that ended in 1992. State-owned Petroecuador replaced Texpet as operator in 1990.

Chevron, which took over Texpet's parent Texaco Inc. in 2001, says it is being held accountable for environmental damaged caused by Petroecuador. It says Texpet spent $40 million on environmental clean-up and received a release of liability from the Ecuadorian government before leaving the country.

It further alleges corruption of the Ecuadorian judicial system. The lawsuit will be decided in a court in the small town of Lago Agrio.

Damage claims, based on estimates by a court appointee, exceed $27 billion.

Dozinger, a law school friend of and fund-raiser for US President Barack Obama, said Chevron's filing for international arbitration will not affect the legal case.

He listed legal decisions against Chevron, saying they "help explain the company's timing in filing the arbitration claim."

And he said outcome of the arbitration move won't affect plans to seize Chevron's assets if the company loses the lawsuit.

"This could end up being one of the biggest forced asset seizures in history, and it could have a significant disruptive impact on the company's operations," he said.

Bill seeks disclosure of foreign payments

Five US senators have introduced a bill which would require companies with stock traded on US exchanges to report payments to foreign governments for oil, gas, and mineral extraction in their regular Securities and Exchange Commission filings.

The measure is designed to prevent governments in countries rich with natural resources from hiding payments they receive from energy and mineral producers to finance corrupt activities, the lawmakers said.

"History shows that oil and gas reserves and minerals can be a bane, not a blessing, for poor countries, leading to corruption, wasteful spending, military adventurism, and instability," said Richard P. Lugar (R-Ind.), ranking minority member of the Senate Foreign Relations Committee and the bill's primary sponsor.

"Too often, oil money intended for a nation's poor lines the pockets of the rich or is squandered on showcase projects instead of productive investments," he continued.

Sens. Benjamin L. Cardin (D-Md.), Russell J. Feingold (D-Wis.), Charles E. Schumer (D-NY), and Roger F. Wicker (R-Miss.) co-sponsored the measure.

Comments on 5-year OCS plan surpass 530,000

The number of public comments on the US Minerals Management Service's evolving 5-year Outer Continental Shelf plan has surpassed 530,000, MMS Director S. Elizabeth Birnbaum said on Sept. 25.

The US Department of the Interior agency received the comments after Interior Secretary Ken Salazar added 6 months on Feb. 10 to obtain additional input on a draft proposed plan that his predecessor, Dirk A. Kempthorne, launched in late summer 2008.

MMS had counted more than 350,000 submissions after the extended comment period expired on Sept. 21, Birnbaum said (OGJ Online, Sept. 24, 2009). The total passed 530,000 after the agency reviewed more submissions, including several which had been mailed at the last minute, she indicated.

She said it will probably take several weeks to review and analyze the comments. After that time, the agency will initiate environmental analysis and public scoping opportunities on the draft proposed plan, Birnbaum said. ✦

Exploration & Development — Quick Takes

Montana's Elm Coulee to top 200 million bbl

Elm Coulee field, Montana's primary Bakken shale oil producing field discovered in 2000, is a giant that is expected to recover more than 200 million bbl.

The field has more than 600 wells that produce primarily from the middle Bakken, Stephen Sonnenberg and Aris Pramudito of the Colorado School of Mines wrote in the American Association of Petroleum Geologists Bulletin.

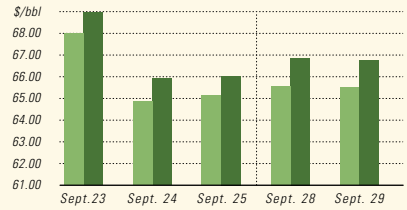
Elm Coulee has produced 78.4 million bbl of 42° gravity oil and 55.7 bcf of gas through December 2008. Oil in place is estimated at 5 million bbl/sq mile.

The Bakken total interval, consisting of an upper shale, middle silty dolostone, and lower siltstone, is 10-50 ft thick with 8-14 ft of vertical pay, and the field covers 450 sq miles in Richland County.

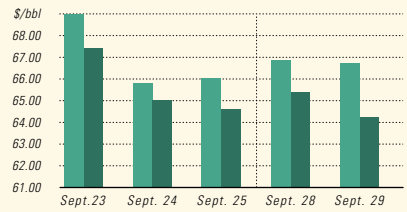
Initial production is 200-1,900 b/d at horizontal wells and

Industry Scoreboard

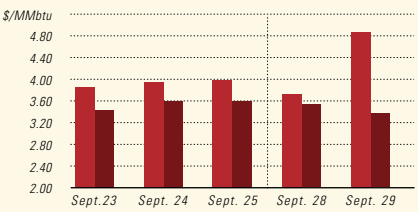
IPE BRENT / NYMEX LIGHT SWEET CRUDE



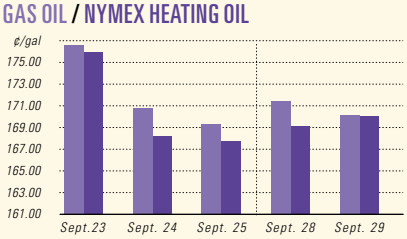
WTI CUSHING / BRENT SPOT



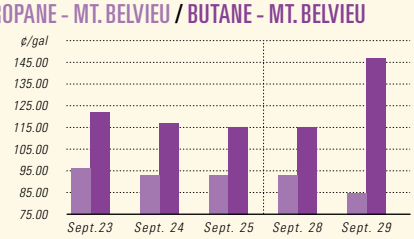
NYMEX NATURAL GAS / SPOT GAS - HENRY HUB



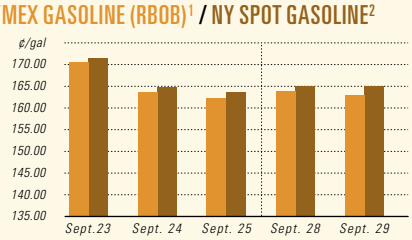
IPE GAS OIL / NYMEX HEATING OIL



PROPANE - MT. BELVIEU / BUTANE - MT. BELVIEU



NYMEX GASOLINE (RBOB)[1] / NY SPOT GASOLINE[2]



[1]Reformulated gasoline blendstock for oxygen blending.
[2]Nonoxygenated regular unleaded.

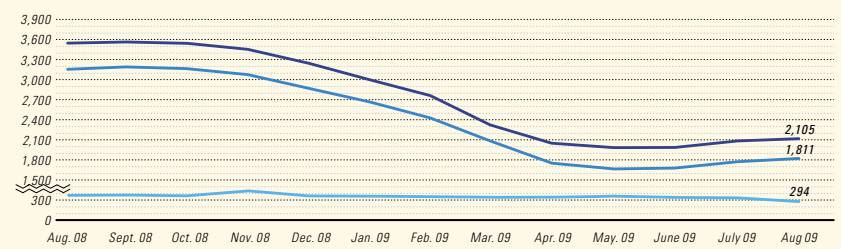
US INDUSTRY SCOREBOARD — 10/5

Latest week 9/18	4 wk. average	4 wk. avg. year ago[1]	Change, %	YTD average[1]	YTD avg. year ago[1]	Change, %
Demand, 1,000 b/d						
Motor gasoline	9,138	8,747	4.5	9,002	9,027	–0.3
Distillate	3,409	3,708	–8.1	3,597	3,955	–9.1
Jet fuel	1,451	1,541	–5.8	1,396	1,584	–11.9
Residual	499	517	–3.5	576	626	–8.0
Other products	4,707	3,889	21.0	4,210	4,458	–5.6
TOTAL DEMAND	19,204	18,402	4.4	18,781	19,650	–4.4
Supply, 1,000 b/d						
Crude production	5,279	4,309	22.5	5,227	5,014	4.2
NGL production[2]	2,208	1,992	10.8	2,011	2,132	–5.7
Crude imports	9,342	9,185	1.7	9,269	9,811	–5.5
Product imports	2,429	2,989	–18.7	2,756	3,150	–12.5
Other supply[3]	1,683	1,570	7.2	3,058	1,548	97.5
TOTAL SUPPLY	20,941	20,045	4.5	22,321	21,655	3.1
Refining, 1,000 b/d						
Crude runs to stills	14,507	13,541	7.1	14,507	14,697	–1.3
Input to crude stills	14,866	13,926	6.7	14,866	15,038	–1.1
% utilization	84.2	79.1	——	84.2	85.4	——

Latest week 9/18	Latest week	Previous week[1]	Change	Same week year ago[1]	Change	Change, %
Stocks, 1,000 bbl						
Crude oil	335,608	332,753	2,855	290,186	45,422	15.7
Motor gasoline	213,109	207,700	5,409	178,739	34,370	19.2
Distillate	170,754	167,793	2,961	125,449	45,305	36.1
Jet fuel–kerosine	46,199	45,152	1,047	37,087	9,112	24.6
Residual	32,635	33,902	–1,267	35,613	–2,978	–8.4
Stock cover (days)[4]			Change, %		Change, %	
Crude	22.4	22.3	0.4	21.7	3.2	
Motor gasoline	23.3	22.5	3.6	19.8	17.7	
Distillate	50.1	48.8	2.7	32.0	56.6	
Propane	66.6	64.4	3.4	60.4	10.3	
Futures prices[5] 9/25			Change		Change	%
Light sweet crude ($/bbl)	68.43	71.36	–2.93	97.29	–28.86	–29.7
Natural gas, $/MMbtu	3.80	3.52	0.27	7.54	–3.75	–49.7

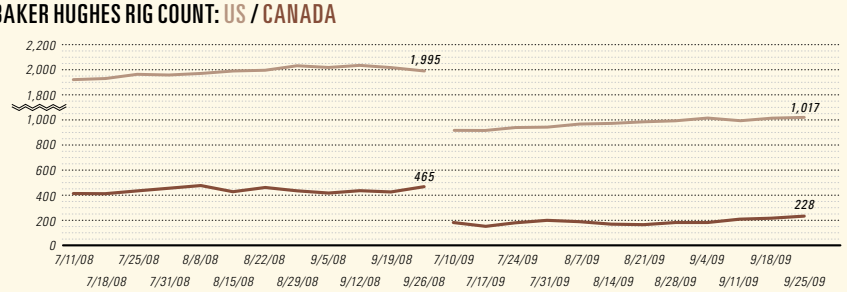
[1]Based on revised figures. [2]Includes adjustments for fuel ethanol and motor gasoline blending components. [3]Includes other hydrocarbons and alcohol, refinery processing gain, and unaccounted for crude oil. [4]Stocks divided by average daily product supplied for the prior 4 weeks. [5]Weekly average of daily closing futures prices.
Sources: Energy Information Administration, Wall Street Journal

BAKER HUGHES INTERNATIONAL RIG COUNT: TOTAL WORLD / TOTAL ONSHORE / TOTAL OFFSHORE



Note: Monthly average count

BAKER HUGHES RIG COUNT: US / CANADA



Note: End of week average count

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generally less than 100 b/d at vertical wells. Formation depth is 8,500-10,500 ft.

"The Elm Coulee field illustrates that the Bakken petroleum system has enormous potential for future oil discoveries in the Williston basin," the authors wrote.

Bakken oil production predated Elm Coulee at Antelope field in 1953 and Elkhorn Ranch field in 1961, both in North Dakota. Elkhorn Ranch field had the play's first horizontal well, in the upper Bakken in 1987.

BLM seeks views on Tumbleweed II gas project

The US Bureau of Land Management will open a public comment period on Sept. 30 on an environmental analysis of the proposed Tumbleweed II natural gas project in eastern Utah, BLM's Vernal, Utah, field office announced.

It said that the project area contains 7,655 acres 32 miles south of Ouray, Utah, about 45 acres of which would be disturbed by the proposed development.

The applicant, Denver-based Stewart Petroleum Corp., plans to construct six well pads, drill eight gas wells, and construct 4.2 miles of new or upgraded road and 12.3 miles of pipelines, according to the BLM field office.

It said that it will accept comments on the EA, which it will post online, through Oct. 16.

Kuwait Energy due IFC aid for Egypt, Yemen

Kuwait Energy Co. has secured $50 million from the International Finance Corp. for exploration and development in Egypt and Yemen and support of its environmental and social management activities.

In Egypt, KEC has interests in three onshore producing assets (Area A in the Gulf of Suez and the East Ras Qattara and Burg el Arab concessions, both in the Western Desert), one development asset (Abu Sennan in the Western Desert), and an early exploration asset (Block 6 in Southern Egypt).

In Yemen, KEC has one producing asset (Block 43, onshore, Central Yemen) and interests in six exploration assets, all onshore in Central Yemen with the exception of Block 15 (off Al Mukalla in the Gulf of Aden). Block 43 is expected to cease production shortly.

The company recently announced oil discoveries at Shukheir Northwest in Area A along the Gulf of Suez coast and Shahd Southeast and Rana Southeast in the East Ras Qattara south of Alexandria. It plans to drill five exploration wells and five development wells before yearend.

In August, the company reported a new oil field, Al Zahraa, in East Ras Qattara. It was KEC's fourth discovery in the country, producing 2,615 b/d of oil, and is operated by Sipetrol. KEC has a 49.5% working interest.

According to the company's second quarter results, it was producing an average of 1,120 boe/d of oil in Yemen.

The IFC and Kuwait Energy have drafted a detailed environmental and social action plan for Egypt and Yemen. "The environmental and social management plan will be implemented over the next year in a series of gradual steps starting this month, September 2009," an IFC spokesman told OGJ.

The bank will also assist with a potential listing on an international stock exchange in 2010 by carrying out an in-depth corporate governance assessment of Kuwait Energy.

Established in Kuwait in August 2005, Kuwait Energy is an independent petroleum company with operations across the Middle East, North Africa, Eastern Europe, and Pakistan. ✦

Drilling & Production — *Quick Takes*

Cabot ordered to cease Marcellus fracs

State regulators ordered Cabot Oil & Gas Corp., Houston, to cease hydraulic fracturing in northeastern Pennsylvania in connection with surface spills.

After three spills in one week, the Pennsylvania Department of Environmental Protection ordered Cabot to develop within 14 days an updated and accurate Pollution Prevention and Contingency Plan and Control and Disposal Plan for all permitted well pad sites in Susquehanna County.

The department required Cabot to perform an engineering study of all equipment and work practices associated with hydraulic fracturing at all wellsites in the county within 21 days. The study must include a detailed evaluation and explanation of the causes of the three spills and establish corrective measures.

Cabot is required to implement within 21 days recommendations and requirements contained in DEP's approved Pollution Prevention and Contingency Plan, the Control and Disposal Plan, and the engineering study.

The company also must place the approved Pollution Prevention and Contingency Plan and Control and Disposal Plan in a conspicuous location at each permitted wellsite and provide a copy to each contractor and subcontractor working at any wellsite. Contractors and subcontractors cannot begin work at any wellsite until they receive the two plans.

Cabot is cooperating with the agency, said Dan O. Dinges, chairman, president, and chief executive officer.

"The only acceptable practice for Cabot is to be in full compliance with all environmental and regulatory policy; therefore, we are working cooperatively with the regulators," Dinges said.

Cabot, which said its drilling and production operations aren't affected, said its Marcellus production reached a high of 52 MMcfd at the end of last week. The company is drilling seven wells.

"Contributing to the increase was our most recent horizontal completion which experienced a 24-hr initial production rate greater than 10 MMcfd and a 30-day average rate of 10.8 MMcfd," said Dinges. The well is making 11.1 MMcfd.

The combination of this well, other primarily vertical completions, and initial production streams from two horizontal wells that are cleaning up led to the 52 MMcfd rate.

From the first seven horizontal wells that have been producing for varying time frames, two have produced more than 1 bcf, and combined those two wells have a 90-day production average of 6 MMcfd.

Separately, DEP issued a notice of violation to Cabot for the

third spill at the Heitsman well in Dimock Township that occurred Sept. 22. The violations noted are nearly the same as in DEP's Sept. 22 notice of violation issued to Cabot for the other two spills.

E.On installs Babbage gas platform

E.On Ruhrgas AG is installing its first operated gas production platform in the UK southern North Sea, which is expected to process gas from Babbage field in April 2010.

The Babbage platform took 10 months to complete; the field is 80 km off the coast of the UK in 42 m of water. It will produce 2 million cu m/day of gas. The field is expected to produce more than 5 billion cu m of gas. The total investment in the development of the Babbage field will amount to more than €300 million.

E.On and partners plan to drill five wells in the field in two phases until 2011. The Babbage reservoir lies about 3,200 m below the seabed. The gas will be transported to West Sole and onward to the Dimlington terminal at Humberside (OGJ Online, Oct. 10, 2008).

Babbage interests are E.On 47%, Dana Petroleum PLC 40%, and Centrica Resources 13%.

Pemex lets contract for southern Mexico

Petroleos Mexicanos has let a $11.2 million contract to Wood Group Pressure Control (WGPC), part of John Wood Group PLC, to provide 125 wellheads and christmas trees for onshore oil and gas fields in southern Mexico.

The wellheads will be manufactured in WGPC's Monterrey, Mexico, facility. The wellheads will be installed in five fields: Comalcalco, Reforma, Cardenas, Delta de Tonala, and Ciudad Pemex. The wellheads will be supported by WGPC's Villahermosa and Poza Rica service centers.

StatoilHydro lets contract for Gullfaks A upgrade

StatoilHydro has awarded Aker Solutions a 50 million kroner front-end engineering design (FEED) study for upgrading the Gullfaks A drilling facilities.

The scope of the work for the study includes new equipment to increase drilling capacity and modification of existing installations offshore. The study will consider the possibility to upgrade the drilling capacity to reach 10 km, including heavy lifting to install a new derrick. The FEED also will include improvement of environment, health, and safety upgrading for the equipment.

Work under the contract starts immediately and the FEED will be completed in April 2010.

Santos-led JV lets contract for gas field

The Santos-led joint venture has awarded engineering and construction company Subsea 7 an $80 million contract to install a subsea pipeline for the Casino-Henry gas field development in the Otway basin off western Victoria.

The work includes installation of a 22-km pipeline that will connect the subsea production tress at the Henry-2 and nearby Netherby fields. Subsea 7 also will install four rigid spool pieces and a 22-km electrohydraulic umbilical cable from Casino-4 to the Pecten East field.

The project management and engineering work will begin immediately in Subsea 7's Singapore office. Offshore onsite operations will begin at yearend when the Seven Navica pipelay and construction vessel arrives.

The Rockwater 2 diving support vessel, which recently worked on BHP Billiton's Stybarrow oil field development off Western Australia, also will be in attendance for the Santos contract.

The Casino-Henry field complex lies in 56-72 m of water about 30 km south of Port Campbell on the Victorian coast.

Casino has been on stream for a number of years via pipeline to an onshore gas processing plant near Port Campbell.

Henry, discovered in 2005, is about 18 km off Victoria in 65 m of water. Reserves are estimated to be 150 PJ of dry gas.

Netherby-1 lies 4 km north of Henry and was found in July 2008.

Santos has a 50% interest and operatorship. Australian Worldwide Exploration and Mitsui E&P Australia have 25% each.

UT assessing carbon storage in Gulf of Mexico

The University of Texas at Austin will use $6 million in federal and state grants to identify possible carbon sequestration sites on state-owned property under the Gulf of Mexico.

The US Department of Energy issued a $4.8 million grant as part of the American Recovery and Reinvestment Act of 2009. The Texas General Land Office issued a $1.2 million grant to assess the potential for an offshore carbon repository.

Tip Meckel, a research associate at the Bureau of Economic Geology, a research unit at the UT Jackson School of Geosciences, said Texas state lands in the gulf already are one of the most geologically studied areas worldwide.

Texas state ownership extends 12 nautical miles offshore compared to 3 miles for all other states except Florida.

ION Geophysical, a company that acquires and processes seismic data for the oil and gas industry, donated UT researchers access to extensive regional seismic datasets.

Formosa Plastics and its subsidiary, Neumin Production Co., have provided researchers with a 3D seismic survey valued at $3.3 million.

After developing a regional picture of potential storage areas, researchers will identify a select number of sites for intense study where they will collect new site-specific data and drill core samples.

Researchers will compile a detailed geological site characterization of specific reservoirs that might be used to store industrial carbon dioxide emissions.

Besides UT, research partners include Sandia Technologies LLC, Los Alamos National Laboratory, and the Environmental Defense Fund (EDF).

EDF will assess environmental risks and collaborate with international organizations planning or already conducting offshore carbon storage. ✦

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Processing — Quick Takes

Aramco lets contracts for Shaybah NGL program

Saudi Aramco has awarded KBR a contract for an undisclosed sum for the front-end engineering and design (FEED) and project management services (PMS) for its Shaybah natural gas liquids program at Shaybah field in Saudi Arabia.

KBR will provide FEED and PMS to develop the process design, layout, develop equipment and material specifications, prepare bid packages and develop an estimate for the construction for several projects related to the Shaybah NGL program facilities.

KBR also will assist Aramco in managing and directing the work related to other Shaybah program projects, which are "designed to help meet the rising domestic demand for gas and feedstocks for petrochemical projects," Aramco said.

Work on the project is expected to begin in October.

Tesoro reports fire knocked out at refinery

A fire that erupted early Sept. 28 in the coking unit of Tesoro Corp.'s 100,000-b/cd Wilmington, Calif., refinery, has been extinguished, the San Antonio-based company reported.

No injuries have been reported, Tesoro said, adding that the cause of this incident is under investigation and the amount of damage to the affected unit is unknown at this time. "Other units at the refinery are currently operating but at reduced rates," the company said. Tesoro acquired the refinery from Shell Oil Products US in early 2007 (OGJ Online, Jan. 29, 2007). ✦

Transportation — Quick Takes

AIPN publishes model form for LNG sales

Publication of a new model form master LNG sale and purchase agreement by the nonprofit Association of International Petroleum Negotiators aims at creation of a secondary market for LNG that will "facilitate trading and arbitrage of LNG cargoes."

The agreement form helps the industry establish a "uniform short-term and spot sales agreement,…thereby reducing transaction time, cost, and uncertainty," said the announcement.

Publication concludes an effort to "create a model contract that balances the interests of sellers and buyers, is geographically neutral, and contains all of the provisions that most parties will require" in a master LNG sale and purchase agreement. It includes alternatives and options as well as guidance notes for users.

The move caps 3 years of effort by AIPN's drafting committee that consisted of more than 150 industry representatives, including members from many of the major LNG sellers, buyers, transporters, and traders worldwide, according to the announcement of the association's board of directors. The committee, cochaired by Steven Miles of Baker Botts LLP, Houston, and Harry W. Sullivan Jr., ConocoPhillips, Houston, held more than 15 meetings and five workshops in seven countries on five continents.

According to the association, this form is the latest in a "series of hydrocarbon-related model contracts" it has published to "facilitate the negotiation of energy transactions around the globe."

Founded in 1981, AIPN has 2,600 members in more than 80 countries, representing international oil and gas companies, governments, law firms, multilateral organizations, and academic institutions.

LNG power contract let to Tag Pacific

Tag Pacific Ltd., Sydney, through its subsidiary MPower, has been awarded a $32 million (Aus.) power contract for the Gorgon-Jansz LNG gas development on Barrow Island off Western Australia. The initial 2-year contract is for the design, manufacture, and commissioning of a 28-Mw electric power generation plant to be used for the construction and commissioning phase of the megaproject. TAG says it is possible the Gorgon joint venture will increase the scope of the contract, bumping the value up to $40 million (Aus.). The contract is a critical component in the Gorgon-Jansz construction phase and will require complex engineering to meet the environmental challenges of the project.

The $43 billion (Aus.) Gorgon-Jansz development on Barrow consists of a three-train LNG plant producing a total of 15 million tonnes/year of LNG as well as a 300-TJ/day domestic gas plant.

First LNG is due in 2014 and domestic gas by the end of 2015.

Pemex lets contract for Chicontepec pipeline

Petroleos Mexicanos (Pemex) awarded a $12.4 million contract to Insituform Technologies Inc.'s Mexican joint venture United Pipeline de Mexico de CV (UPM) for construction, replacement, and rehabilitation of about 40 km of pipelines in Mexico's Chicontepec oil region. Insituform subsidiaries Corrpro Cos. Inc. and Bayou Co. Inc. will provide cathodic protection and field joint coating services for the project.

Insituform expects work on this project to begin in November and to take about 16 months to complete. UPM will oversee new construction, including corrosion protection services, and rehabilitation of more than 24 km of pipeline using Insituform's proprietary Tite Liner polyethylene lining system. The new and rehabilitated pipelines will transfer Chicontepec oil from wellheads to production facilities. Insituform acquired Bayou and Corrpro in February and March, respectively.

Analysts previously reported Mexico's Energy Minister Georgina Kessel saying the country would have to reevaluate its strategy for Chicontepec given production shortfalls. Reports indicated Chicontepec would produce 60,000 b/d of oil by yearend against a previous forecast of 72,000 b/d (OGJ Online, Sept. 8, 2009). ✦

Correction

In the Sept. 21 special report, OGJ150, reserves and production for Plains Exploration & Production Co. were incorrectly stated. The following are corrections with their respective new rankings in parentheses: Liquids production-20.294 million bbl (No. 14 worldwide and No. 10 US), Natural gas production-79.254 bcf (No. 29 worldwide and No. 28 US), Liquids reserves–177.707 million bbl (No. 16 worldwide and No. 16 US), Natural gas reserves–686.357 bcf (No. 37 worldwide and No. 36 US).

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Calendar

✦ Denotes new listing or a change in previously published information.

OIL&GAS JOURNAL online

Additional information on upcoming seminars and conferences is available through OGJ Online, Oil & Gas Journal's Internet-based electronic information source at http://www.ogjonline.com.

2009

OCTOBER

Interstate Oil and Gas Compact Commission Annual Meeting (IOGCC), Biloxi, Miss., (405) 525-3556, (405) 525-3592 (fax), e-mail: iogcc@iogcc.state.ok.us, website: www.iogcc.state.ok.us. 4-6.

SPE Annual Technical Conference and Exhibition, New Orleans, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 4-7.

Canadian Offshore Resources Exhibition & Conference (CORE), Halifax, NS, (902) 425-4774, (902) 422-2332 (fax), e-mail: events@otans.com, website: www.otans.com. 5-8.

World Gas Conference, Buenos Aires, +54 11 5252 9801, e-mail: registration@wgc2009.com, website: www.wgc2009.com. 5-9.

ISA EXPO, Houston, (919) 549-8411, (919) 549-8288 (fax), e-mail: info@isa.org, website: www.isa.org. 6-8.

Kazakhstan International Oil & Gas Exhibition & Conference (KIOGE), Almaty, +44 (0) 207 596 5233, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 6-9.

Power-Gen Asia Conference, Bangkok, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.powergenasia.com. 7-9.

Renewable Energy World Asia Conference & Expo, Bangkok, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.renewableenergyworld-asia.com. 7-9.

NPRA Q&A and Technology Forum, Ft. Worth, Tex., (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npra.org. 11-14.

API Fall Petroleum Measurement Standards Meeting, Calgary, Alta., (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 12-15.

GPA Houston Annual Meeting, Houston, (918) 493-3872, (918) 493-3875 (fax), e-mail: pmirkin@gpaglobal.org, website: www.gpaglobal.org. 13.

Expandable Technology Forum, Houston, +44 (0) 1483 598000, e-mail: sally.marriage@otmnet.com, website: www.expandableforum.com. 14-15.

International Oil & Gas Exploration, Production & Refining Exhibition, Jakarta, +44 (0)20 7840 2100, +44 (0)20 7840 2111 (fax), e-mail: ogti@oesallworld.com, website: www.allworldexhibitions.com. 14-17.

SPE/EAGE Reservoir Characterization and Simulation Conference and Exhibition, Abu Dhabi, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 18-21.

GSA Annual Meeting, Portland, (303) 357-1000, (303) 357-1070 (fax), e-mail: meetings@geosociety.org, website: www.geosociety.org. 18-21.

Oil Shale Symposium, Golden, Colo., (303) 384-2235, e-mail: jboak@mines.edu, website: www.mines.edu/outreach/cont_ed/oilshale/. 19-23.

Oil and Gas Transportation in the CIS and Caspain Region Annual Meeting, Moscow, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. 20-22.

SEG International Exposition and Annual Meeting, Houston, (918) 497-5500, (918) 497-5557 (fax), e-mail: register@seg.org, website: www.seg.org. 25-30.

SPE/IADC Middle East Drilling Conference & Exhibition, Manama, +971 4 390 3540, +971 4 366 4648 (fax), e-mail: spedal@spe.org, website: www.spe.org. 26-28.

PICT-Passive Inflow Control Technology Meeting, Copenhagen, +44 (0) 1483-598000, e-mail: Dawn.Dukes@otmnet.com, website: www.inflowcontrol.com. 27-28.

Louisiana Gulf Coast Oil Exposition (LAGCOE), Lafayette, (337) 235-4055, (337) 237-1030 (fax), e-mail: lynette@lagcoe.com, website: www.lagcoe.com. 27-29.

North African Oil and Gas Summit, Tunis, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. 27-29.

Offshore Middle East Conference & Exhibition, Manama, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.offshoremiddleeast.com. 27-29.

✦Vietnam Saigon Oil and Gas Expo, Saigon, +49 40 30101 266, +49 40 30101 936 (fax), e-mail: industrial.pr@sgs.com. website: www.sgs.com/industrial. 29-31.

NOVEMBER

Deep Offshore Technology International Conference & Exhibition, Monte Carlo, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.deepoffshoretechnology.com. 3-5.

IPAA Annual Meeting, New Orleans, (202) 857-4722, (202) 857-4799 (fax), website: www.ipaa.org. 4-6.

GPA North Texas Annual Meeting, Dallas, (918) 493-3872, (918) 493-3875 (fax), e-mail: pmirkin@gpaglobal.org, website: www.gpaglobal.org. 5.

Capture and Geological Storage of CO_2 Symposium, Paris, +33 1 47 52 67 21, +33 1 47 52 70 96 (fax), e-mail: patricia.fulgoni@ifp.fr, website: www.CO2symposium.com. 5-6.

Sulphur International Conference and Exhibition, Vancouver, +44 20 7903 2058, +44 20 7903 2172 (fax), e-mail: cruevents@crugroup.com, website: www.sulphurconference.com. 8-11.

Gas Turbine Users International (GTUI) Annual Conference, Calgary, Alta., +9714 804 7738, +9714 804 7764 (fax), e-mail: info@gtui.org, website: www.gtui.org. 8-13.

IADC Annual Meeting, Miami, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 9-10.

Multiphase User Roundtable-South America, Rio de Janeiro, (979) 268-8959, (979) 268-8718 (fax), e-mail: Heather@petroleumetc.com, website: www.mur-sa.org. 9-10.

API Fall Refining and Equipment Standards Meeting, Dallas, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 9-11.

Digital E&P Event, Houston, (646) 200-7444, (212) 885-2733 (fax), e-mail: cambrosio@wbresearch.com, website: www.digitaleandp.com. 9-11.

Calendar

NPRA/API Operating Practices Symposium, Dallas, (202) 457-0480, (202) 457-0486 (fax), website: www.npra.org. 10.

Petroleum Association of Wyoming (PAW) Annual Oil & Gas Statewide Reclamation Conference, Casper, (307) 234-5333, (307) 266-2189 (fax), e-mail: cheryl@pawyo.org, website: www.pawyo.org. 10.

Deepwater Operations Conference & Exhibition, Galveston, Tex., (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.deepwateroperations.com. 10-12.

SPE International Oil and Gas China Conference & Exhibition, Beijing, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 10-12.

NPRA International Lubricants & Waxes Meeting, Houston, (202) 457-0480, (202) 457-0486 (fax), website: www.npra.org. 12-13.

ASME International Mechanical Engineering Congress and Exposition (IMECE), Lake Buena Vista, Fla., (973) 882-1170, (973) 882-1717 (fax), e-mail: infocentral@asme.org, website: www.asme.org. 13-19.

Latin America LPG Seminar, Miami, (713) 331-4000, (713) 236-8490 (fax), e-mail: ts@purvingertz.com, website: www.purvingertz.com. 16-19.

IADC Completions Conference, Houston, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 17.

Houston Energy Financial Forum, Houston, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.accessanalyst.net. 17-19.

IADC Well Control Asia Pacific Conference & Exhibition, Bangkok, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 18-19

✦Energise Your Future Forum, Paris, +33 0 1 47 96 91 68, e-mail: claude.leonard@bostik.com, website: www.energiseyourfuture.com. 18-20..

DECEMBER

Advanced Contract Risk Management Europe for Oil & Gas, Aberdeen, +44 0 207 368 9300, e-mail: enquire@iqpc.co.uk, website: www.contractriskmanagement.MAC=11579.003EDIARY. 1-2.

Refining and Petrochemicals in Russia and the CIS Countries Annual Meeting, Amsterdam, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. 1-3.

World LNG Summit, Barcelona, +44 (0)20 7978 0000, +44 (0)20 7978 0099 (fax), e-mail: info@thecwcgroup.com, website: www.thecwcgroup.com. 1-4.

European Drilling Engineering Association Expandables, Multilaterals and Technologies Meeting, Vienna, +44 (0) 1483-598000, e-mail: Dukes@otmnet.com, website: www.dea-europe.com. 3-4.

✦International Petroleum Technology Conference (IPTC), Doha, +971 4 390 3540, e-mail: iptc@iptcnet.org, website: www.iptcnet.org/2009. 7-9.

Nuclear Power International Conference, Las Vegas, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.nuclearpowerinternational.com. 8.

Power-Gen International Conference, Las Vegas, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.power-gen.com. 8-10.

PIRA Natural Gas Markets Conference, New York, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 14-15.

PIRA Understanding Natural Gas and LNG Markets Seminar, New York, (212) 686-6808, (212) 686-6628 (fax), website: www.pira.com. 14-15.

PIRA Understanding Global Oil Markets Seminar, New York, (212) 686-6808, (212) 686-6628 (fax), website: www.pira.com. 16-17.

2010

JANUARY

Plant Maintenance in the Middle East & Annual Meeting, Abu Dhabi, +44 (0) 1242 529 090, +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 10-13.

Oil & Gas Maintenance Technology Conference & Exhibition Co-located with Pipeline Rehabilitation and Maintenance, Manama, Bahrain, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.oilandgasmaintenance.com. 18-20.

Pipeline Rehabilitation & Maintenance Co-located with Oil & Gas Maintenance Technology, Manama, Bahrain, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.pipeline-rehab.com. 18-20.

World Future Energy Summit, Abu Dhabi, +971 2 4090 445, +971 2 444 3768 (fax), e-mail: ludoiva.sarram@reedexpo.ae, website: www.worldfutureenergysummit.com. 18-21.

SPE Oil and Gas India Conference and Exhibition, Mumbai, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 20-22.

SPE Deep Gas Conference, Manama, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 24-27.

API Exploration and Production Winter Standards Meeting, New Orleans, (202) 682-8000, (202) 682-8222, website: www.api.org. 25-29.

Health, Safety, Environment & Training Conference & Exhibition, Houston, (713) 292 1945, (713) 292 1946 (fax), e-mail: info@iadc.org, website: www.iadc.org. 26-27.

The European Gas Conference and Annual Meeting, Vienna, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. 26-28.

API/AGA Joint Committee on Oil and Gas Pipeline Welding Practices Conference, New Orleans, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 27-29.

Annual Gas Arabia Summit, Abu Dhabi, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. Jan. 31- Feb. 3.

International Process Analytical Technology Forum (IFPAC), Baltimore, (847) 543-6800, (847) 548-1811 (fax), e-mail: info@ifpacnet.org, website: www.ifpac.com. Jan 31-Feb 4.

FEBRUARY

Deep Offshore Technology International Conference & Exhibition, Houston, (713) 963-6271, (713) 963 6296 (fax), e-mail: registration@pennwell.com, website: www.dotinternational.net. 2-4.

IADC/SPE Drilling Conference and Exhibition, New Orleans, (713) 292 1945, (713) 292 1946 (fax), e-mail: info@.org, website: www.iadc.org. 2-4.

Russia Offshore Annual Meeting, Moscow, +44 (0) 20 7067 1800, +44 (0) 20 7242 2673 (fax), website: www.theenergyexchange.co.uk. 2-4.

Global Petrochemicals Conference & Annual Meeting, Vienna, Austria, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. Feb 9-11.

SPE International Symposium & Exhibition of Formation Damage Control, Lafayette, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 10-12.

NAPE Expo, Houston, (817) 847-7701, (817) 847-7703 (fax), e-mail: info@napeexpo.com, website: www.napeonline.com. Feb 11-12.

Annual Petroleum Coke Conference, Seattle, (832) 351-7828, (832) 351-7887 (fax), e-mail: petcoke.conference@jacobs.com, website: www.petcokes.com. 12-13.

SPE North Africa Technical Conference & Exhibition, Cairo, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 14-17.

IP Week, London, +44 0 20 7467 7132, +44 0 20 7255 1472 (fax), e-mail: jbia@energyinst.org.uk, website: www.energyinst.org.uk. 15-18.

Pipeline Pigging & Integrity Management Conference & Exhibition, Houston, (713) 521-5929, (713) 521-9255 (fax), e-mail: clarion@clarion.org, website: www.clarion.org. 16-18.

Pipe Line Contractors Association Annual Conference (PLCA), Scottsdale, Ariz. (214) 969-2700, e-mail: plca@plca.org, website: www.plca.org. 17-21.

Laurance Reid Conditioning Conference, Norman, Okla., (512) 970-5019, (512) 233-2877 (fax), e-mail: bettyk@ou.edu, website: www.lrgcc.org. 21-24.

International Petrochemicals Technology Conference & Exhibition, Madrid, +44 (0) 20 7357 8394, +44 (0) 20 7357 8395 (fax), e-mail: enquiries@europetro.com, website: www.europetro.com. 22-23.

Photovoltaics World Conference & Exhibition, Austin, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.Photovoltaicsworldevent.com. 23-25.

Renewable Energy World North America Conference & Expo, Austin, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.renewableenergyworld-events.com. 23-25.

SPE Unconventional Gas Conference, Pittsburgh, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 23-25.

International Downstream Technology & Catalyst Con-

ference & Exhibition, Madrid, +44 (0) 20 7357 8394, +44 (0) 20 7357 8395 (fax), e-mail: enquiries@europetro.com, website: www.europetro.com. 24-25.

SPE/IADC Managed Pressure Drilling & Underbalanced Operations Conference and Exhibition, Kuala Lumpur, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 24-25.

Nitrogen + Syngas International Conference and Exhibition, Bahrain, +44 20 7903 2058, +44 20 7903 2172 (fax), e-mail: cruevents@crugroup.com, website: www.nitrogenandsyngas2010.com. Feb. 28-Mar. 3.

MARCH

APPEX Conference, London, +44 0 20 74341399, +44 0 20 74341386 (fax) website: www.appexlondon.com. 2-4.

Subsea Tieback Forum & Exhibition, Galveston, Tex., (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.subseatiebackforum.com. 2-4.

Middle East Geosciences Conference and Exhibition, Manama, +973 17 550033, +973 17 553288 (fax), e-mail: fawzi@aeminfo.com.bh, website: www.geobahrain.org. 7-10.

SPE Hydrocarbon Economics and Evaluation Symposium, Dallas, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 8-9.

Annual International LPG Seminar, The Woodlands, Tex., (713) 331-4000, (713) 236-8490 (fax), website: www.purvingertz.com. 8-11.

CERA Week, Houston, (617) 866-5992, e-mail: info@cera.com, website: www.cera.com. 8-12.

NPRA Security Conference & Exhibition, The Woodlands, Tex., (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npradc.org. 9-10.

Annual European Fuels Conference, Paris, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 9-12.

NACE International Corrosion Conference & Expo, San Antonio, (281) 228-6200, (281) 228-6300 (fax), e-mail: firstservice@nace.org, website: www.nace.org. 14-18.

International Pump Users Symposium, Houston, (979) 845-7417, (979) 845-1835 (fax), e-mail: inquiry@turbo-lab.tamu.edu, website: http://turbolab.tamu.edu. 15-18.

API Spring Committee on Petroleum Measurement Standards Meeting, Dallas, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 15-18.

Gas Asia, Kuala Lumpur, +44 (0) 1242 529 090, +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 16-18.

Oil and Gas Africa Exhibition & Conference, Cape Town, SA, +27 21 713 3360, +27 21 713 3366 (fax), e-mail: events@fairconsultants.com, website: www.fairconsultants.com. 16-18.

Offshore Asia Conference & Exhibition, Kuala Lumpur, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.offshoreasiaevent.com. 16-18.

Turkish International Oil & Gas Conference & Showcase (TUROGE), Ankara, Turkey, +44 (0) 207 596 5000, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 16-18.

Electric Light & Power Executive Conference, Tampa, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.elpconference.com. 21-22.

Calendar

NPRA Annual Meeting, Phoenix, (202) 457-0480, (202) 457-0486 (fax), website: www.npra.org. 21-23.

GPA Annual Convention, Austin, Tex., (918) 493-3872, (918) 493-3875 (fax), e-mail: pmirkin@gpaglobal.org, website: www.GPAglobal.org. 21-24.

AIChE Spring National Meeting & Global Congress on Process Safety, San Antonio, (203) 702-7660, (203) 775-5177 (fax), website: www.aiche.org. 21-25.

Howard Weil Energy Conference, New Orleans, (504) 582-2500, website: www.howardweil.com/energy-conference.aspx. 21-25.

✦Gas Turbine Users International (GTUI) Annual Conference, Calgary, Alta., +9714 804 7738, +9714 804 7764 (fax), e-mail: info@gtui.org, website: www.gtui.org. 21-26.

Middle East Downstream Week & Annual Meeting, Abu Dhabi, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 22-25.

IADC Drilling HSE Asia Pacific Conference & Exhibition, Singapore, (713) 292 1945, (713) 292 1946 (fax), e-mail: info@iadc.org, website: www.iadc.org. 23-24.

SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition, The Woodlands, Tex., (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 23-24.

Middle East Refining Conference & Annual Meeting, Abu Dhabi, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 23-24.

Base Oils and Lubricants in Russia and CIS & Annual Meeting, Moscow, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 23-25.

SPE Intelligent Energy Conference and Exhibition, Utrecht, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 23-25.

Utility Products Conference & Exposition, Tampa, (918) 831-9160, (918) 831-9161

(fax), e-mail: registration@pennwell.com, website: www.utilityproductsexpo.com. 23-25.

DistribuTECH Confernece & Exhibition, Tampa, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.distributech.com. 23-25.

Offshore West Africa Conference & Exhibition, Luanda, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.offshorewestafrica.com. 23-25.

Georgian International Oil, Gas, Energy and Infrastructure Conference & Showcase (GIOGIE), Tbilisi, +44 (0) 207 596 5000, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 24-25.

NPRA International Petrochemical Conference, San Antonio, (202) 457-0480, (202) 457-0486 (fax), website: www.npra.org. 28-30.

APRIL

ATYRAU North Caspian Regional Oil, Gas and Infrastructure Exhibition, Atyrau, +44 (0) 207 596 5000, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 6-8.

Rocky Mountain Unconventional Resources Conference & Exhibition, Denver, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.RMURconference.com. 6-8.

Oil & Gas WestAsia Exhibition in conjunction with SPE EOR Conference, Muscat, +968 24660124, +968 24660125 (fax), e-mail: omanexpo@omantel.net.om, website: www.ogwaexpo.com 11-13.

SPE EOR Conference at Oil & Gas West Asia, Muscat, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 11-13.

AAPG Annual Convention and Exhibition, New Orleans, (918) 560-2679, (918) 560-2684 (fax), e-mail: convene@aapg.org, website: www.aapg.org 11-14.

IPAA OGIS, New York City, (202) 857-4722, (202) 857-4799 (fax), website: www.ipaa.org. 12-14.

SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Rio de Janeiro, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 12-14.

IADC Well Control Europe Conference & Exhibition, Aberdeen, (713) 292 1945, (713) 292 1946 (fax), e-mail: info@iadc.org, website: www.iadc.org. 13-14.

GPA Mid-continent Annual Meeting, Oklahoma City, (918) 493-3872, (918) 493-3875 (fax), e-mail: gpa@gasprocessors.com, website: www.gasprocessors.com. 15.

International Liquefied Natural Gas Conference and Exhibition, Oran, +44 (0) 20 7596 5000, +44 (0) 20 7596 5111 (fax), website: www.lng16.org. 18-21.

Oil & Gas WestAsia Conference, Muscat, +968 24660124, +968 24660125 (fax), e-mail: omanexpo@omantel.net.om, website: www.ogwaexpo.com. 19-21.

Hannover Messe Pipeline Technology Trade Show, Hannover, +49 0 511 89 0, +49 0 511 89 32626 (fax), website: www.hannovermesse.de. 19-23.

✦Texas Alliance Annual Meeting and Expo, Wichita Falls, (940) 723-4131, (940) 723-4132 (fax), e-mail: texasalliance@texasalliance.org, website: www.texasalliance.org. 20-21.

API Pipeline Conference and Cybernetics Symposium, New Orleans, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 20-22.

SPE Improved Oil Recovery Symposium, Tulsa, (918) 366-7033, (918) 366-7064 (fax), e-mail: IOR@SPEIOR.ORG, Website: www.speior.org. 26-28.

Middle East Fertilizer Symposium & Annual Meeting, Abu Dhabi, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 26-28.

API Spring Refining and Equipment Standards Meeting, New Orleans, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 26-28.

API/NPRA Spring Operating Practices Symposium, New Orleans, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 27.

MAY

Offshore Technology Conference (OTC), Houston, (972) 952-9494, (972) 952-9435 (fax), e-mail: service@otcnet.org, website: www.otcnet.org/2010. 3-6.

GPA Permian Basin Annual Meeting, Midland, Tex., (918) 493-3872, (918) 493-3875 (fax), website: www.gasprocessors.com. 4.

Asian Biofuels, New Feedstocks and Technology Roundtable, Singapore, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 4-6.

OGU/Uzbekistan International Oil & Gas Exhibition & Conference, Tashkent, +44 (0) 207 596 5000, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 11-13.

International School of Hydrocarbon Measurement, Norman, Okla., (405) 325-1217, (405) 325-1388 (fax), e-mail: lcrowley@ou.edu. Website: www.ishm.info. 11-13.

APPEA Conference & Exhibition, Brisbane, 07 3229 6999, 07 3220 2811 (fax), e-mail: jhood@appea.com.au. website: www.appea.com.au. 16-19.

Mediterranean Offshore Conference & Exhibition, Alexandria, Egypt, +20 2 27065210, +20 2 25184980 (fax), e-mail: conference@omc.it, website: www.moc2006.com. 18-20.

NPRA National Safety Conference & Exhibition, San Antonio, (202) 457-0480, (202) 457-0486 (fax), website: www.npra.org. 19-20.

IADC Drilling Onshore Conference & Exhibition, Houston, (713) 292 1945, (713) 292 1946 (fax), e-mail: info@iadc.org, website: www.iadc.org. 20.

SPE International Conference on Oilfield Corrosion, Aberdeen, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 24-25.

ILTA Annual International Operating Conference & Trade Show, Houston, (202) 842-9200. (202) 326-8660, e-mail: info@ilta.org, website: www.ilta.org. 24-26.

Petrotech Middle East Refining and Petrochemicals Exhibition & Conference, Manama, +973 1755 0033, +973 1755 3288 (fax), e-mail: aeminfo@aeminfo.com.bh, website: www.aeminfo.com.bh. 24-26.

NPRA Reliability and Maintenance Conference and Exhibition, San Antonio, (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npradc.org. May 25-28.

SPE International Conference on Oilfield Scale, Aberdeen, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 26-27.

SPE Western North America Regional Meeting, Anaheim, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 26-30.

JUNE

Caspian International Oil & Gas/Refining & Petrochemicals Exhibition & Conference, Baku, +44 (0) 207 596 5000, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 1-4.

AchemAsia, Beijing, 0049 69 75 64 0, 0049 69 75 64 201 (fax), website: www.achemasia.de. 1-4.

ASME Annual Meeting, Pittsburgh, (800) 843-2763, (973) 882-1717 (fax), e-mail: infocentral@asme.org, website: www.asme.org. 4-9.

Society of Petroleum Evaluation Engineers (SPEE) Annual Meeting, Victoria, BC, (713) 651-1639, (713) 951-9659 (fax), website: www.spee.org. 5-8.

Asia Oil & Gas Conference, Kuala Lumpur, 65 6338 0064, 65 6338 4090 (fax), e-mail: info@cconnection.org, website: www.cconnection.org. 6-8.

IAEE International Conference, Rio de Janeiro, (216) 464-5365, (216) 464-2737 (fax), e-mail: iaee@iaee.org, website: www.usaee.org. 6-9.

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SUBSEA Asia, Kuala Lumpur, +44 0 20 7840 2102, +44 0 20 7840 2119 (fax), e-mail: sluff@oesallworld.com, website: www.allworldexhibitions.com.oil. 9-11.

EAGE Conference and Exhibition/SPE EUROPEC, Barcelona, Spain, +31 88 995 5055, +31 30 634 3524 (fax), e-mail: eage@eage.org, website: www.eage.org. 14-17.

ASME Turbo Expo, Glasgow, Scotland, (800) 843-2763, (973) 882-1717 (fax), e-mail: infocentral@asme.org, website: www.asme.org. 14-18.

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Professional ethics

Warren R. True
Chief Technology Editor-LNG/Gas Processing

Most veteran Oil & Gas Journal editors have heard so many industry talks that memory blurs them after only a few years. That's why one such talk last spring stands out for me.

Professional engineers in the Houston Chapter of the Gas Processors Association had reminded its program committee months earlier of their need, for Texas certification purposes, to obtain at least an hour/year of formal training in ethics.

Ethics?

Given how headlines at the time centered on massive breaches of business ethics among US financial institutions, that topic certainly seemed timely. And the resulting talk was one of the most informative in my years with OGJ.

Presenting it was Daryl Koehn, who at one time worked as a senior product manager for investment vehicles at First National Bank of Chicago. Armed now with a PhD in ethics from the University of Chicago, she directs the Center for Business Ethics Studies at the Cameron School of Business at the University of St. Thomas in Houston. She also holds the Cullen Chair in Business Ethics.

Being the product of a liberal arts education, however, I was scratching my head a bit as to why engineers had to complete ethics training to be certified. So, last month I visited her to find out.

Professionalism

For Prof. Koehn, it starts with the concept of "professionalism," a word that derives from Latin for "to affirm openly" with an implication ("pro") of "happening before."

In taking an oath as a professional, an engineer acknowledges a promise to abide by certain guidelines that ensure ethical completion of tasks.

Like what? Well, explained Prof. Koehn, an engineer has an ethical obligation to resist clients' demands that violate his ethical oath to, for example, employ safe building practices.

In designing a new refinery, a process engineer must bear in mind his or her higher responsibilities to the safety of other people and, we have now come to think, the environment. He must oppose shortcuts that might save money or time but—in his or her professional judgment—may risk lives.

It's not just a nod to "sound practices," Prof. Koehn told me. It's an obligation imposed by the engineer's professed oath. It's the "public dimension," a covenant implicit in the status of being a professional.

Moreover, such ethical considerations pervade not only all professions but all societies. Ethical considerations, she said, are what make us human: the "values of ethical behavior transcend cultural values."

In other words, an engineer is first a human being, with all the ethical responsibilities implicit in that fact. No one, especially an engineer, can simply "do his job." To live ethically, to work ethically, she would say, that engineer must at all times be aware of the ethical implications of that job.

And media?

Equally as professionals, journalists have ethical guidelines. Foremost among them is to let facts tell the story and to prevent one's prejudices or opinions from dictating what facts are relevant.

Trade publications, such as OGJ, that serve specific industries—they're known as "business-to-business" communications—have additional ethical worries: Editors must resist commercial efforts to influence what material is selected or what topics are covered.

But, as for engineers, periods of contracting markets and intensified competition bring temptation with them. For far too many publications, that slope is simply far too slippery.

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OGJ editors take their responsibility to readers as seriously as any professionals anywhere, and the magazine's management fully supports them. ✦

Editorial

Confusion over subsidies

US President Barack Obama summoned the oil and gas industry to two tasks when he called last month for an end to subsidies for fossil energy. One is to address confusion over the meaning of "subsidy." The other is to force attention to a central motive of Obama's appeal.

Subsidies take many forms. The US government provides a subsidy when it suspends royalty for initial production of oil and gas from deep waters of the Gulf of Mexico. The Iranian government provides a subsidy when it caps the price of gasoline. Economically, these two types of subsidy are poles apart. One encourages production; the other encourages consumption.

Shunning distinctions

Many other methods of subsidization are in place worldwide, not all of them as clearly definable as royalty relief and price controls. Their effects vary. In the US, for example, percentage depletion represents a subsidy to the extent it enables an independent producer ultimately to charge to depletion more than total spending on a property. It's vital to capital formation for small producers. But the accounting method represents much less subsidization of oil production, for example, than a direct tax credit does of ethanol blended into gasoline.

Politics shuns these distinctions. In his statement on ending fossil energy subsidies after the G-20 summit in Pittsburgh last month, Obama mentioned only one example: Indonesia's politically difficult dismantling of fuel price caps. His analysis seemed to aim at consumption subsidies of that type. But then he cited US efforts, all of which target production. The view thus seems to be developing that all subsidies are alike, and those applying to fossil energy must cease.

The oil and gas industry can't let this confusion dominate political debate. If it does, any tax measure that applies to oil and gas and that can be branded a subsidy will be in jeopardy.

An example of the confusion that can arise on this subject appeared in a September report on US fuel subsidies by the Environmental Law Institute. The report's headline conclusion is that during 2002-08, subsidies to fossil fuels totaled $72 billion while subsidies to renewable energy amounted to only $29 billion. The report's authors regret this disparity as contradictory to policy aspirations on climate change and energy security.

Promoters of renewable energy will pounce on the findings to seek more government help, arguing that an increase in aid will be only fair in view of what fossil-energy producers receive. The study, however, doesn't address what producers receive. Instead, it assesses "subsidy value through the cost of a subsidy to the government, rather than through its value to the recipient."

So $6.4 billion of the total fossil-energy "subsidy" represents block grants to states under the Low Income Home Energy Assistance Program. And $6.2 billion of it is for the Strategic Petroleum Reserve. The biggest single chunk is a $15.3 billion estimate of what the US government doesn't collect because of royalty payments to foreign governments accounted for as income taxes and therefore creditable against US taxes. Another major category is $14.1 billion in credits for production of nonconventional fuels, which mainly help coal producers.

Much of that $72 billion subsidy total thus does little for producers of oil and gas. The producing industry, though, can expect to be bludgeoned with the number in discussions about tax policy. It will have to address exaggerations about timing preferences, such as the ability to charge intangible drilling costs immediately to expense rather than amortizing them over asset lives, the "subsidy" value of which relates mainly to the time value of money.

Poisonous campaign

While seeking perspective in the subsidy debate, producers also must confront the stated reason Obama wants to press the issue. His administration sees merit in cutting domestic production of oil and gas. It has adopted an extreme environmental assertion that lowering production ultimately lowers consumption of fuels that emit greenhouse gases and thus should be a policy goal.

An assault on vaguely defined subsidies threatens to become a tool of that economically poisonous campaign. Producers must not let it happen. ✦

Human rights lawsuits: mitigating a new threat

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Over the past decade, lawsuits have proliferated in US courts alleging human rights abuses against multinational companies. The oil and gas industry has been a primary target.

Last winter, Chevron stood trial in a high-profile case in San Francisco, accused of responsibility for deaths and torture carried out by the Nigerian military aboard a company oil platform. In June, a case against Shell in New York, involving accusations that Nigerian security forces tortured and murdered environmental protestors, settled on the courthouse steps. Two cases against Occidental Petroleum, one alleging that the company supported military attacks in Colombia and another that it supported murder and torture by paramilitary squads guarding the company's pipeline in Ecuador, are pending in Los Angeles.

It is paramount that companies take simple and direct steps to protect against potential human rights problems.

These cases, and many others like them in courts around the country, create stark threats for oil and gas companies. The highly charged cases not only impose substantial potential liability and mammoth legal expenses but also bring steady and biting negative publicity, disrupt operations, harm future business, and create vast other indirect costs.

Given the current litigation trend, it is paramount that companies take simple and direct steps to protect against potential human rights problems as a complement to existing corporate responsibility programs.

The litigation landscape

Most of the human rights cases currently being filed against multinational companies are based on a once-obscure US law, the Alien Tort Statute (ATS). On the books since 1789, the ATS permits foreign claimants to file tort actions in US federal courts based on a handful of serious international crimes—"violations of the law of nations"—wherever on the globe they are committed.

For nearly 200 years, the law remained essentially unused. It was revived in 1980 in a case where Paraguayan citizens filed suit in New York against a Paraguayan police official for acts of torture and murder of a relative in Paraguay. When the courts allowed the lawsuit to proceed, dozens of others quickly followed.

Initially, these cases largely sought to emphasize unpunished international human rights abuses against government officials or oppressive regimes, leading to hefty damage awards regularly in excess of $10 million and sometimes $100 million.

Beginning in the mid-1990s, a new ATS trend emerged—suing transnational companies based on their overseas activities. The trend began with cases against Texaco based on its operations in Ecuador and picked up steam in 1997 after a federal court ruled that Unocal and its executives could be held liable under the ATS for alleged slave labor, murder, rape, and forced relocation of villagers by the Burmese military in connection with the construction of a pipeline.

Scores of multimillion-dollar lawsuits against corporations have been filed based on a variety of alleged abuses.

Since that time, scores of multimillion-dollar lawsuits against corporations have been filed based on a variety of alleged abuses. To date, some 128 ATS cases now have been brought against corporate defendants, the vast majority of which have been filed over the last

decade–a figure that does not include additional human rights cases brought under other laws. While that trend of human rights lawsuits has targeted numerous sectors, given the nature and complexities of the industry and its overseas presence, oil, gas, and other extractive companies are by far the most frequent corporate defendants.

Of equal or greater risk is the dramatic harm these lawsuits can do to reputations.

The stakes

The potential legal liability in these human rights cases, in which graphic allegations of murder, torture, environmental devastation, and slave labor are the norm, is uniformly substantial. Unocal is estimated to have settled its ATS lawsuit for $30-60 million. In October, a federal court in Florida entered an $80 million ATS judgment against a Dutch company for trafficking workers and forced labor. Shell settled at a relative bargain of $15.5 million.

However, of equal or greater risk is the dramatic harm these lawsuits can do to reputations. Even where the company prevails in court, the costs are high, as favorable decisions often take years to obtain and the interim publicity can taint a corporate reputation, drive away investors and consumers, and create sharp tensions with host governments and operational environments to a point where even a threat of a human rights lawsuit can create immediate problems.

That concern, while always present, is more acute in a recession. When budgets are tight, consumers and investors pay close attention to their spending. In a true Darwinian sense, stronger brands survive and even grow, while weaker ones struggle. A key reputation differentiator in the marketplace is a company's perceived commitment to social good. As study after study confirms, a company's perceived social reputation is important to retaining existing customers and investors and to attracting new ones.

That positive social reputation is particularly significant for public companies. Analyses verify the importance of corporate character to sophisticated investors and to the impact of reputation on gaps between a company's book value and market capitalization.

Indeed, the current downturn notwithstanding, socially conscious investment funds, which have grown fifteenfold in the past 10 years, continue to thrive. In short, public consciousness of corporate reputation is increasingly vital, and the harm of an ATS suit is particularly significant right now.

Act now

Given the hazards in these high-profile, high-damage lawsuits, coupled with their rapid growth in US courts, it is critical for oil and gas corporations to pay close attention to human rights concerns.

Certainly, over the past several years, the oil and gas industry steadily has been incorporating some of those concerns into business planning through corporate responsibility programs and other voluntary sustainability initiatives. Those efforts have been motivated in no small part by economics. Companies face demands from funding sources, such as the International Finance Corp., Export Development Canada, and others that require attention to sustainability standards; close monitoring by nongovernmental organizations (NGOs) of the conduct of multinational companies; and pressures by foreign governments to meet minimum standards in operations or be denied a license to operate. The result has been general industry operating guidelines designed to improve community relationships and resource management.

A company's perceived social reputation is important to retaining existing customers and investors and to attracting new ones.

Those types of sustainability efforts no doubt can improve relations in local operating environments, which may reduce the tensions and threats that often result in ATS and other human rights lawsuits. However, the efforts are not designed to directly address human rights problems, and in a period of falling stock prices for public companies, and in which most companies face challenges in attracting investments for their projects, even the hint of a human rights issue can have lasting effects.

The following are five concrete, inexpensive, and easy-to-implement steps designed to integrate sustainability, legal, and communication resources to address human rights issues directly and keep a company from being the latest casualty to the human rights litigation trend.

1. *Develop a code.* To the extent you have no written code of conduct that covers human rights, draft one. Emphasize in broad terms the company's commitment to promoting and protecting human rights, health and safety of its workers, the community, and other stakeholders and to probing potential abuses. While the code cannot realistically include or anticipate every human rights-related cause of action, write it to cover relevant types of conduct by employees and agents.

   Tailor the code to the company's locations. Depending on the situation, a parent and all corporate subsidiaries or affiliates might have their own codes. Consider incorporating or referencing provisions contained in relevant legal instruments, such as the Voluntary Principles on Security and Human Rights (www.voluntaryprinciples.org), the International Labor Organization core conventions (www.ilo.org), or the Extractive Industries Transparency Initiative principles (http://eitransparency.org/eiti/principles).

2. *Conduct a legal and communication risk analysis.* For oil and gas companies, it is critical to understand the nature of the impact of operations on stakeholders and the degree of risks that you might face. Detailed assessments or matrices, which consider applicable laws, regulations, norms, and expectations, and prioritize levels of risk, can help provide that understanding.

Corporate responsibility and other voluntary sustainability programs are not designed to directly address human rights problems.

Although there is no single right approach to conducting an assessment, include within the scope of your review the key factors that can lead to human rights problems, an assessment that involves understanding problems that have come before—which for oil and gas companies generally include use of force by security personnel, labor issues, and health and environmental matters—and predicting those that may come next. Seek to determine the risks and vulnerabilities based on country conditions, identify prior problems that have arisen in the relevant country in your and other industries, and analyze the role the government may play in your operation.

Ascertain the highest and lowest risk areas and, working with legal counsel, chart them to allow for precise and tailored mitigation approaches. Depending on the subject being scrutinized, it may be prudent to engage community members and other shareholders, or even government officials, and seek information from external company sources.

The main point is that to fully understand and evaluate the impact of an operation or operational risks, the more information the better. The risks identified, of course, should then be addressed as part of the company's compliance program.

3. *Tailor your compliance program.* For the risk areas identified on the assessment, ensure there are proper controls in place. That should include, at a minimum, integrating human rights issues into your compliance program, which in turn should include internal and external components.

- **Internal.** Internally, train key employees and officers on relevant human rights matters, and ensure they have high sensitivity to early indicators of a potential threat. Have knowledgeable personnel available to answer questions promptly, since human rights problems often arise quickly and without notice. Provide and publicize mechanisms for employees and nonemployees to report potential problems, and strive to foster a culture in which employees know that reports will be taken seriously and not lead to retribution.

Where problems are identified, they should be investigated, and immediate appropriate actions—such as disciplinary measures, remediation plans, or informing appropriate authorities—should be pursued. Consider asking relevant employees to sign periodic certifications affirming that they are unaware of human rights problems, and conduct periodic audits or reviews to gauge whether the program is working and to identify problems, control failures, and identify areas of improvement.

Where litigation does occur, the possibility can be increased of obtaining an early dismissal or a positive jury decision and countering the wave of negative publicity.

- **External.** Externally, carefully scrutinize formal and informal relationships with third parties. Most corporate human rights lawsuits are premised not on misdeeds committed by corporations or their employees but on the acts of others, with victims seeking to pin wrongdoings on the company itself through theories of vicarious liability.

Accordingly, conduct basic due diligence—through internet and public filing searches, background and reference checks, and other standard means—for overseas suppliers, agents, and contractors to ensure there is no history of human rights alarms. Consider drafting a third-party code of conduct, or at least including in third-party contracts clauses that require adherence to the company's code of conduct in whole or as relevant.

Consider provisions in third-party contracts that require key third-party employees to undergo training and provide periodic certifications, declare the company's expectation that the third party will adhere to pertinent local civil and criminal laws and international instruments, and identify the company's degree of responsibility over and rights in the third party; if none exist, make that clear.

Also consider including requirements and expectations regarding third-party subagents. Those third-party contracts also might include provisions that permit some means of monitoring third-party conduct. That monitoring should be pursued throughout the relationship through periodic inspections or audits, annual interviews, and other similar methods.

Of maximum importance to external compliance controls is placing a close watch on government service providers. Under the ATS, "violations of the law of nations" traditionally have been limited to misconduct by states or state officials, and many human rights claims tend to arise based on actions by, or in conjunction with, state actors.

In light of that, monitor formal and informal relationships with govern-

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ment and quasigovernment entities. While not always feasible, limit direct reliance for services on government entities or regimes with reputations for human rights abuses. That is especially true for security services, as corporate ATS and other human rights cases—as with Chevron, Shell, Occidental, Unocal, and others—frequently arise based on actions committed by police, military, or paramilitary units actually or allegedly operating on a company's behalf.

For companies that have no choice but to rely on foreign governments for various services that create human rights concerns, strive to enter into contracts or memorandums of understanding with relevant government entities. Those agreements should delineate respective roles and responsibilities. If the company lacks the authority to supervise or direct government employees, or the selection or assignments of government personnel, make that explicit.

Include, if possible, provisions stating clearly that all parties will comply with pertinent domestic and international human rights laws and conventions, violations of those laws will be investigated and reported to appropriate authorities, and suspected wrongdoers will be suspended from performing work for the company pending the outcome of those inquiries. If government entities will agree to provide relevant employees with human rights training, that is even better.

4. *Watch for consolidations.* The need to carefully scrutinize third parties extends in particular to consolidations. Far too often in the oil and gas industry, human rights problems are inherited from others. Given the state of economy, mergers and partnerships are increasing in frequency. Companies with good balance sheets have started to take advantage of the current situation to make acquisitions, which may continue throughout the year.

Conducting effective due diligence in those consolidation efforts is a strategic necessity. A failure to include human rights issues within the scope of that review, particularly for partnerships with, or acquisitions of, companies without strong compliance programs or who operate in jurisdictions without strong regulatory regimes, is potentially catastrophic. It can lead to a multimillion-dollar problem and deeply tarnish reputations for problems not of your making.

Just as with a third-party agent, include human rights issues within the scope of due diligence during the acquisition or investment process. Review public materials for potential human rights red flags. Determine whether lawsuits have been filed against other companies based on operations in the region. Ask basic questions of management and local residents about conflicts, lawsuits, and incidents. Request documents reflecting complaints, on or near-site injuries, or company internal or external investigations. A few simple inquiries might help prevent a major headache.

5. *Be prepared for rapid response.* Although some ATS cases are premised on a pattern of conduct over a lengthy period, most involve rapid responses to pressure-filled situations.

To minimize potential exposure, it is vital to be able to identify red flag circumstances in their nascent state and have a defined plan in place. That plan should include a coordinated effort between trained personnel at the relevant location, informed public relations staff, and knowledgeable legal personnel. Include immediate notification requirements to this core group and perhaps others when a red flag situation erupts. Consider requiring immediate investigations and, where appropriate, recording known facts to ensure an accurate record is made for possible later use.

While many such inquiries may be probed and handled internally, for more serious matters, independent external inspections may be warranted. And of course, where actual misdeeds are suspected, make sure to take immediate action.

Escalating hazard

Though the risk of a human rights lawsuit will not disappear, particularly in light of the growing litigation trend, these steps, beyond corporate responsibility programs, will help you reduce the likelihood of encountering this escalating hazard. And where litigation does occur, the possibility can be increased of obtaining an early dismissal or a positive jury decision and countering the wave of negative publicity.

In other words, while ATS lawsuits may continue to flow against multinational companies, responsible companies can mitigate their risks and work proactively to avoid falling prey to the trend. ✦

The authors

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Boxer-Kerry climate bill arrives amid praise, criticism

Nick Snow
Washington Editor

The US Senate's latest effort to address global climate change emerged after several weeks of anticipation as Barbara Boxer (D-Calif.) and John F. Kerry (D-Mass.) introduced their bill on Sept. 30.

The measure immediately drew applause from environmental and other organizations, and fire from oil and gas associations and other business groups. It also provided a basis for the Senate to begin serious work in the next few weeks to create a final bill, which probably will have to go to conference. The House passed its own bill, HR 2454, by seven votes on June 26.

"This bill addresses major challenges of our generation: protecting our children and the Earth from dangerous pollution; putting America back in control of our energy future; creating the policies that will lead to millions of new jobs; and through our example, inspiring similar actions around the world to avoid an unstable and dangerous future," said Boxer, who chairs the Senate Environment and Public Works Committee.

"Global warming is our challenge," she urged during a press briefing with Kerry, adding, "Economic recovery is our challenge. American leadership is our challenge. Let's step up right now. Let's not quit until we have fulfilled our responsibility to our children and our grandchildren."

Kerry said, "Our health, our security, our economy, our environment all demand we reinvent the way America uses energy. Our addiction to foreign oil hurts our economy, helps our enemies, and risks our security. By taking decisive action, we can and will stop climate change from becoming a 'threat multiplier' that makes an already dangerous world staggeringly more so."

Party-line responses

Congressional responses generally followed party lines on both sides of the Capitol. US House Speaker Nancy Pelosi (D-Calif.) called the bill "a strong foundation for Senate action on our clean-energy future." Senate Republican Conference Chairman LaMar Alexander (Tenn.) called it "fancy, complicated words for high-cost energy that sends jobs overseas looking for cheap energy" and suggested that Congress take "practical steps to produce low-cost, clean, carbon-free energy and create jobs" instead.

James M. Inhofe (R-Okla.), the Environment and Public Works Committee's ranking minority member, said that hearings on the bill should be fair and open because the measure, as introduced, lacks several important details. "While I've noted that the Democrats have the votes to pass this bill through the committee, that does not mean Republicans will stand down. We will expose this bill and its contents throughout every step of this process," he said.

In her remarks to reporters, Boxer said the first major part of the bill, formally known as Clean Energy Jobs and American Power Act, includes authorizations, all of which would be eligible for appropriations and some which are eligible for both appropriations and allowances.

"Some of these are enhanced from the Waxman-Markey bill; some are new," Boxer said, referring to the House's bill which was cosponsored by Energy and Commerce Committee Chairman Henry A. Waxman (D-Calif.) and Edward J. Markey (D-Mass.), who chairs the committee's Energy and Environment Subcommittee.

Authorizations in the Senate bill include investments in natural gas, new electricity transmission infrastructure, nuclear research and development and worker training, and "green economic development; agricultural and forestry offset opportunities; investments in transit systems and incentives for efficient hybrid and electric motor vehicles; and "adaptation authorizations that include wildfire prevention, flood control, water infrastructure, and investments in coastal communities and wildlife protection," Boxer said.

"Our bill gives a much stronger role to mayors and local governments," she added.

Allowances, incentives

The bill's second major section would set up what Boxer called "pollution reduction and investment incentives" containing "strong principles for market transparency and oversight" and setting up an offsets integrity office, she continued. "Allowances in this section will be detailed in the chairman's mark," she said.

"We have put into this section a soft collar to address cost containment and limit speculation while maintaining the environmental integrity of the pollution cap. And our bill does not add one penny to the deficit," Boxer added. Several witnesses at a Sept. 16 Senate Energy and Natural Resources hearing on a carbon cap-and-trade system's potential economic impacts suggested that a ceiling, or collar, would be needed as well as a floor to price carbon credits for trading.

The incentives are designed to keep US businesses competitive as the country pursues the bill's pollution reduction goals, the sponsors said. It would mandate carbon emission cuts of 20% by 2020 and 50% by 2050 from 2005 levels, according to an overview at the Environment and Public Works Committee's web site. It said that the system would apply only to major polluters, initially about 7,500 facilities which account for nearly 75% of total US carbon emissions. "Over 98% of American

businesses and all farmers are exempt," it said.

Environmental leaders applauded the bill. Sierra Club Executive Director Carl Pope called it an important step forward, adding that he was pleased the measure would set a strong, short-term carbon reduction target and retain the US Environmental Protection Agency authority to regulate global warming emissions. Natural Resources Defense Council Pres. Frances Beineke said the goal of a 20% cut in carbon emissions by 2020 was "strong and achievable."

American Petroleum Institute Pres. Jack N. Gerard was more critical. "Boxer-Kerry leaves unaddressed key elements of how it intends to constrain carbon emissions," he said on Sept. 29 after examining an early copy of the measure. "Unfortunately, it appears to be following the pattern the House followed, which resulted in a political bidding process that picked winners and losers."

'Goes further'

National Petrochemical & Refiners Association Pres. Charles T. Drevna noted, "While the bill passed in the House was controversial enough given its ambitious reduction targets, the Senate bill goes even further in seeking more unrealistic reductions that will impose onerous regulatory burdens on domestic refiners amidst fierce global competition and increased costs on the driving public, farmers, and truckers."

Drevna added, "The Senate proposal also fails to harmonize existing federal laws specifically by removing the preemption of New Source Performance Standards for capped sources, which means that large facilities will be subject to both the emissions cap and EPA [New Source Performance Standard] regulations. Like its House counterpart, this bill will only further weaken our nation's energy security."

America's Natural Gas Alliance, which represents 28 of the country's leading independent producers representing more than 40% of the nation's total gas supply, took a more positive view. "The Clean Energy Jobs and American Power Act provides a starting point with 'natural gas placeholder' language. The placeholder establishes a new EPA program to provide financial incentives to power projects that reduce greenhouse gas emissions that are not otherwise eligible for tax credits," explained ANGA Pres. Rod Lowman.

Lowman said the bill includes provisions that will let ANGA help develop language that effectively promotes gas as part of the national climate solution. "With the right policy incentives, natural gas can and should be the foundation of the solution for our energy future. Natural gas can provide dramatic decreases in greenhouse gas emissions and do so more quickly than any other currently viable options. Natural gas can also enhance our nation's energy security through increased use of natu-

ral gas vehicles," Lowman said.

The Industrial Energy Consumers of America, meanwhile, continued to urge Congress to develop global climate change legislation that does not include a carbon cap-and-trade program.

Adopting one without the rest of the world doing the same would place the US at a significant economic disadvantage, IECA warned in a statement. "It is unreasonable to think that we or other countries could force countries to comply with GHG reductions in the event lower GHG emissions means slower economic growth or higher energy costs to their consumers," the group indicated. ✦

Observers question strategy of raising taxes on oil, gas

Nick Snow
Washington Editor

A strategy that diverts federal tax incentives from domestic oil and gas to renewable and alternative energy would quickly increase oil and gas imports, industry observers warned on Sept. 28.

"We need to probe what it actual means to overinvest in oil and gas," said Lucian (Lou) Pugliaresi, president of Energy Policy Research Foundation Inc. (EPRINC) in reference to recent statements by US President Barack Obama and other administration officials.

"But if you reduce what you invest domestically in oil and gas, you increase imports. There's no way to get around it," Pugliaresi told congressional staff members at a Capitol Hill briefing that EPRINC cosponsored with the University of Texas at Austin's Center for Energy Economics and the Brookings Institution.

The organizations hosted the briefing at the requests of US Reps. Cynthia M. Lummus (R-Wyo.) and Harry Teague (D-NM), Pugliaresi noted.

He said White House oil and gas tax proposals in its proposed fiscal 2010 budget would adversely affect downstream as well as upstream operations.

One proposal that would keep refiners from the Section 199 tax exemption available to all other US manufacturers would hit a business with a rate of return significantly lower than other industries, he said. Combined with proposed carbon cap-and-trade costs and existing consumption taxes, EPRINC estimates that losing the tax credit

could reduce US refining capacity by 2 million b/d over time, Pugliaresi said.

Gas demand growth

Even without a federal greenhouse gas emissions control program, stronger US natural gas demand also is inevitable because low-carbon technologies are immature and their costs and timing of deployment are uncertain, observed Michelle M. Foss, chief economist and head of UT-Austin's Center for Energy Economics.

"Demand for gas is going to be robust in the future, especially as people explore new ways to use it," Foss said. "The desire to move away from fuels with higher carbon emissions also is having an impact."

The oil and gas investment climate is similar to that of the pharmaceutical industry because it requires large sums to be committed with slim chances of success, she pointed out.

"I wouldn't call it overinvesting," Foss said. "More people simply need to understand how much money needs to be spent before that first barrel of oil or first cubic foot of gas is produced. Even with all the technology that's available, there's still a substantial risk."

Development of hydraulic fracturing to recover gas from shale formations has improved the domestic resource outlook significantly, Foss said. It also has made water management a key issue in several potential production areas, she pointed out.

"There's a lot of communication across the producing community, state regulatory offices, and the National Energy Technology Laboratory to see what happens in each shale formation," Foss said. "But every formation is different. Parts of each formation are different too."

The overall goal is to use fewer rigs to produce more gas, she explained. "It's extremely exciting, but it's extremely challenging too. We need to consider what the best regulatory environment will be," she said.

Incentives needed

Smaller independent producers would be hit hardest without exemptions for intangible drilling costs, tertiary injectant expenses, enhanced oil recovery costs, and costs for marginally producing wells, several speakers said. They said that these producers, who are not big enough to go to private capital markets for money, must rely on cash flow to stay in business, and that cash flow has fallen with oil and gas prices recently.

Upstream independents who use commodity hedges to keep cash flow steadier also would suffer if proposals to require all over-the-counter transactions to go through regulated exchanges become law, according to Lee O. Fuller, vice-president of government relations at the Independent Petroleum Association of America.

"Using the OTC markets lets them use their reserves as collateral," Fuller explained. "Forcing them onto regulated exchanges requiring cash collateral and daily clearing could lead to more volatile prices because most independent producers could no longer afford to hedge 2 or 3 years of production as they do now."

"Small producers also can't survive without government-supported research at universities like ours," said Van Romero, vice-president of research and development at the New Mexico Institute of Mining and Technology in Socorro, NM.

Romero noted that since the US Department of Energy's fossil fuel research budget has been eliminated, the only federal money available for oil and gas research and development is $35.9 million that the Energy Policy Act of 2005 authorized for unconventional onshore and ultra-deepwater research.

"This is no giveaway to Big Oil as I've heard some people call it," Romero said. "It's directed money, not an appropriation, which supports education of the future oil and gas workforce as well as future technologies' R&D." ✦

Murkowski amendment kept out of EPA appropriation

Nick Snow
Washington Editor

US Senate Democrats kept Lisa Murkowski's (R-Alas.) amendment to restrict US Environmental Protection Agency use of the Clean Air Act (CAA) to greenhouse gases for a year out of the agency's budget on Sept. 24.

Murkowski, who is the Energy and Natural Resources Committee's ranking minority member, said when she introduced the measure on Sept. 23 that it would give Congress time to develop a responsible response to global climate change.

The measure would bar EPA from spending money to regulate GHG emissions from stationary sources under the CAA for a year, she said. It would not apply to preparatory work for any carbon dioxide regulations or any other GHG emissions control activities at the agency, Murkowski emphasized.

EPA proposed an endangerment finding that greenhouse gases contribute to air pollution which may threaten public health or welfare on Apr. 17. "Even if we do make a final positive endangerment finding, that does not necessarily trigger any regulations," an EPA spokesman told OGJ on Sept. 24.

But federal lawmakers and groups pushing for legislation to limit carbon dioxide and other GHG emissions said the proposed endangerment finding, which followed a scientific review that the US Supreme Court ordered in 2007, could set the stage for EPA to regulate greenhouse gases under the CAA.

California's carbon fee

As federal lawmakers discussed the mechanics of a proposed federal greenhouse gas emissions control program, the California Air Resources Board (CARB) imposed the nation's first statewide carbon fee on some 350 businesses.

Its purpose is to pay for implementing a program required under a 2006 law to bring GHG emissions within the state back to estimated 1990 levels by 2020. Part of the initial collections will repay loans incurred to get the GHG reduction program going.

The targeted businesses represent 85% of the state's total GHG emissions, CARB indicated. Estimated costs would be $120/year for a full-service grocery store, $17/year for a family restaurant, and $9/year for a 100-person office. Households would pay another 77¢/year for gas and electricity and 80¢/year for a car driven 15,000 miles and getting 30 mpg.

The plan, which CARB adopted at its Sept. 25 meeting, anticipates collections from businesses including refineries, gasoline and diesel fuel importers, large natural gas distributors and consumers, and plants that burn coal and petroleum coke.

Total payments

They would pay an estimated $63.1 million during fiscal years 2010 and 2011 to cover the GHG reduction program's $36.2 million of operating costs and $26.9 million of debt repayment, according to CARB.

Fees associated with each source would be about $21.6 million for gasoline, $6.6 million for diesel fuel, $14.6 million for natural gas (excluding electricity generation), $2.7 million for refinery gas, $1 million for catalyst coke, $800,000 for petroleum coke, and $500,000 for associated gas, it said.

Refineries in the state will pay $2-6 million/year under the levy not only for on-site emissions but also those by motorists, according to Joe Costantino, manager of CARB's climate change office.

"The place to collect it is at the refineries, but we're really collecting it for the end-users' emissions too," he told OGJ.

Rejected idea

Catherine Reheis-Boyd, executive vice-president and chief operating officer at the Western States Petroleum Association, said the organization was disappointed that CARB rejected the group's proposal to have the state's Board of Equalization, which already collects several oil product taxes at the refinery rack, collect this one too.

It's significant because 40% of the program's carbon fees will come from transportation fuels, she said.

"We're trying to have a fee regulation that actually works and can be legally sustained," she said, adding, "When the collection point is at the refinery gate, there's no way of knowing if the product is going to California, to Arizona, or to Nevada. Consumers in those other states possibly would pay higher costs as a result of a California law."

WSPA also would like the tax to be more transparent. Reheis-Boyd said, "These are tough economic times. Climate change is not going to be free." ✦

'Thinly veiled threat'

In floor remarks on Sept. 24 following a vote to refer proposed US Department of the Interior and EPA budgets, which did not include her amendment to the full Senate, Murkowski described regulating GHG emissions under the CAA as a "thinly veiled threat" against the Senate to force climate legislation action "regardless of where we are in what remains an ongoing and incredibly important debate."

She disputed charges by some environmental and other groups that she was trying to keep EPA from fully using its authority to regulate GHG emissions. "Anyone who reads my amendment will see that I went to great lengths to ensure it does not lead to any unintended or adverse consequences," she said. "It has been drafted and redrafted to limit one action by EPA, for one year, and nothing else. I've been responsive to bipartisan requests, even from members who I knew wouldn't support this amendment, because I am committed to avoiding an overreach."

But Dianne Feinstein (D-Calif.), who chairs the Senate Appropriations Committee's Interior, Environment, and Related Agencies Subcommittee, responded that the proposal would have created serious problems. "Many of us viewed her amendment with substantial alarm," she said, adding that EPA Administrator Lisa P. Jackson sent her a letter the night before indicating that it would keep the agency from promulgated light-duty vehicle emission standards if adopted.

"We can't bury our heads in the sand when it comes to climate change," Feinstein continued. "It makes no sense to put an amendment on the floor which would devastate EPA's authority to regulate [GHG] emissions while the Environment and Public Works Committee is working on its own cap-and-trade bill."

Murkowski said she offered her amendment because a finding of significant deterioration under one CAA section could be applied to others. Extending GHG emissions limits from

motor vehicle to stationary sources could be applied to any source emitting 250 tons/year or more of carbon dioxide under the CAA, she warned. "Realistically, we are talking about any facility heated by conventional fuels that's more than 65,000 sq ft in size," she said.

'At full speed'

EPA apparently has recognized this and proposed moving the exemption limit to 25,000 tons/year, she continued. But CAA does not give the agency this flexibility, making a legal challenge likely and increase the possibility of unsuitably broader regulation, according to Murkowski. "This regulation is a train that could wreck our fragile economy, and it's barreling toward us at full speed," she maintained.

Feinstein said the proposal was not included because it would have exempted refineries, electric power plants, and other large carbon dioxide-emitters from GHG emissions regulation. If the amendment had been considered, she said she would have offered one of her own, which would have exempted small businesses and farms.

Until Congress enacts cap-and-trade legislation, EPA is obligated to regulate greenhouse gases under the CAA, she continued. Jackson has notified the White House's Office of Management and Budget that the agency would exempt sources below 25,000 tons/year and concentrate only on the 13,000 largest carbon emitters, which already are regulated under CAA for soot, sulfur dioxide, and other pollutants, Feinstein said.

Murkowski said she agreed that Congress must act. "I must think that moving climate regulation through EPA is not the most effective way to do this. We need to be driving forward good, thoughtful consideration about ways to respond to climate change," she said.

The National Association of Manufacturers endorsed Murkowski's amendment on Sept. 23. "Supporting the amendment does not convey opposition to climate change policy; it merely allows Congress to do its job," said Jay Timmons, NAM's executive vice-president, in a letter to Senate members. ✦

Business groups ask House panel to modify chemical plant bill

Nick Snow
Washington Editor

Twenty-seven business associations, including seven from the oil and gas industry, expressed concern to leaders of a US House committee on Sept. 28 about three provisions in a bill aimed at protecting chemical plants from terrorism.

The group urged Chairman Henry A. Waxman (D-Calif.) and ranking minority member Joe Barton (R-Tex.) to delete provisions dealing with federal preemption of state and local regulations, citizen lawsuits, and inherently safer technologies (ISTs) from HR 2868.

Rep. Bennie G. Thompson (D-Miss.) introduced the bill, formally called the Chemical Facility Anti-Terrorism Act of 2009, on June 15. The Energy and Commerce Committee's Energy and Environment Committee has scheduled a hearing on the measure and a drinking water system bill sponsored by Waxman for Oct. 1.

"Our industries recognize and take seriously the need to protect our nation's chemical plants, storage facilities, and infrastructure against security threats and potential terrorist attacks," the trade associations said in their letter to Waxman and Barton.

The groups' member companies have worked constructively with the US Department of Homeland Security (DHS) to develop the Chemical Facility Anti-Terrorism Standards (CFATS) and are working to implement them, the letter continued. But the groups also expressed "significant concerns" about the three HR 2868 provisions.

Preemption removal

They said that Section 3109, which would let state and local governments adopt or enforce more-stringent standards than the federal government's, would increase companies' financial burdens without any significant increase in public safety.

"Federal preemption is critical to the legislation's overarching goals," the letter said. "Absent uniform national standards, businesses will be subject to a patchwork of differing and possibly conflicting resolutions."

It said Section 2116, which would allow anyone to sue regulated facilities or DHS to enforce compliance with the act, unsuitably applies private rights which are common in environmental challenges to CFATS's performance-oriented requirements.

"Furthermore, we share DHS's concerns that broad discovery rights in federal lawsuits could lead to public disclosure of classified or highly sensitive information that could assist terrorists," it indicated. "Such information likely would include the types and amounts of chemicals stored at a facility, the specific locations of the chemicals, and the security measures in place to protect the chemicals."

IST provision

Finally, said the groups, they oppose Section 2111 which would require facilities covered under the bill to assess so-called ISTs and to require chemical plants assigned to specific tiers to implement these technologies if DHS orders them to do so.

"This provision essentially provides DHS the authority to implement manufacturing process changes, an action that is unnecessary and potentially very

disruptive to many chemical facilities," they maintained. "The performance-based CFATS already provide chemical facilities with power incentives to implement enhanced safety measures, improve processes, and substitute safer chemicals."

Cost to assess ISTs also would impose financial burdens on smaller facilities which do not manufacture chemicals but simply use or store modest amounts, the letter said. "These operations, already suffering from the ongoing economic crisis, will have even fewer resources to dedicate to actual security enhancements if forced to conduct costly IST assessments," it said.

The oil and gas trade associations that signed the letter included the American Petroleum Institute, Association of Oil Pipe Lines, International Liquid Terminals Association, National Petrochemical & Refiners Association, National Propane Association, Petroleum Equipment Supplies Association, and Petroleum Marketers Association of America. ✦

NPRA: Determine impacts before changing RFS

Nick Snow
Washington Editor

More time should be taken to determine actual impacts before the US Environmental Protection Agency makes significant changes in the federal renewable fuels standard, the National Petrochemical & Refiners Association said on Sept. 25.

"NPRA's concerns with these proposed changes range from the lack of time allowed for implementation of the program to cellulosic availability to implementation of midlevel ethanol blends such as E15 without comprehensive testing and research," noted Charles T. Drevna, the association's president, as NPRA submitted formal written comments on proposed changes to the RFS established by the 2007 Energy Independence and Security Act.

"These concerns expose the fundamental problems with implementing federal fuels mandates, and the unintended consequences are frequently ignored," Drevna said.

In its comments, NPRA said the only workable approach for effectively implementing the proposed changes is to wait until Jan. 1, 2011, or later. "Even if EPA is able to promulgate a final rule before January 2010, it will take until 2011 to accomplish the registrations that are required and to put in place the systems and plans that are necessary for compliance (assuming that EPA can issue the final rule by January 2010)," it said.

The agency should not even try to implement proposed changes by the middle of next year, it continued. "A mid-2010 start date will not provide the regulated parties sufficient time to accomplish the registrations and put plans in place for compliance. Moreover, starting the program in mid-2010 will only add additional complexities," NPRA maintained.

Actual capacity

Demonstrated production capability will be critical as EPA makes its annual assessment of cellulosic biofuel capacity outlined in the proposals, it noted. Relying on planned capacity for such new and proven technologies poses significant risks, it warned.

"When assessing new technologies, EPA must adopt a higher standard that capability must be demonstrated both in terms of the actual fuel being produced and the capacity of the plant to operate reliably at some demonstrated operating capacity," it said. "Obligated parties must not be put in the position of being forced to carry deficits forward due to the unreliability of new technology, or EPA's overly optimistic acceptance of new technology capability claims."

NPRA said it supports prudent development and use of biofuels, including ethanol, to make the US transportation and offroad fuels portfolio more diverse.

"However, before the use of midlevel ethanol blends is permitted, EPA has an affirmative obligation to find, based on comprehensive and unbiased test data, that these blends are safe for consumers, do not harm gasoline-powered engines, and do not lead to increases in emissions from these engines that will harm the environment," it added.

Data submitted by Growth Energy, a fuel ethanol advocacy group, in its petition to raise the allowable ethanol limit in gasoline to 15% from 10% "does not come close to meeting these admittedly and necessarily high standards, and thus the petition must be rejected," NPRA said. ✦

ANGA study cites gas industry's contributions

Nick Snow
Washington Editor

The US natural gas industry supports nearly 3 million American jobs, providing a significant positive impact to the general economy, a study commissioned by America's Natural Gas Alliance concluded.

The study, "The Contributions of the Natural Gas Industry to the US National and State Economies," by IHS Global Insight was the first ever to separate the gas industry's US economic impact from that of the domestic oil industry, ANGA officials said at a Sept. 17 briefing.

It found that the gas industry contrib-

WATCHING THE WORLD

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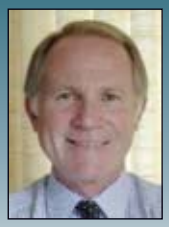


Brazil's brave new world

Brazil's oil and gas industry is looking at some highly significant changes following what officials call the world's largest oil discovery in 30 years—the famed presalt layer.

Dilma Rousseff, chief of staff to Brazil's President Luiz Inacio Lula da Silva and chairman of the board of state-owned Petroleo Brasileiro SA (Petrobras), said her country will exploit the presalt layer for social betterment.

"With the creation of the New Social Fund, Brazil will create a public savings account that funnels presalt revenue into education, science, and technology as part of our fight against poverty," Rousseff said.

Does that sound a little ominous? One thinks immediately of the problems now arising in nearby Venezuela where President Hugo Chavez has turned state-owned Petroleos de Venezuela SA into a cash cow for social development.

Unfortunately, that cash cow is getting leaner all the time, while its milk is on the verge of drying up. Are we going to see the same thing happening to Petrobras?

Unexpected windfall

Rousseff recently wrote that a newly proposed development model is designed to turn the unexpected windfall from the presalt layer towards the public good. To ward off the future oil "curse," she said Brazil is taking "bold steps" along a tightrope.

On one side is Brazil's commitment to remain a reliable development partner to foreign governments and energy companies. On the other is Brazil's desire to control its own resources and use their revenues to "fuel our fight against poverty and improve social equality."

She said, "What's proposed is a New Social Fund that not only would keep these efforts on track for generations to come, but would help shield the economy from the potentially destructive impact of a resource windfall."

She added, "Also helping to fend off the 'curse' is the hard-earned fact that the oil bonanza arrives at a diverse economy and a land rich in many natural resources."

Booming economy

Rousseff said, "Brazil's booming economy, expected to grow about 4% next year, was attractive to foreign investors well before the discovery of the massive pre-salt oil reserves."

Not least, she claimed, "The new legal and regulatory framework submitted to the National Congress aims to preserve this allure."

In the newly outlined production-sharing system, according to Rousseff, "foreigners will remain welcome to bid for contracts to explore and develop oil in association with Petrobras."

One cannot fault Brazil for seeking to use its newly found oil resources for social betterment. However, while aiming to make its way into the brave new world of social betterment, Brazil runs the risk of drawing too many resources away from Petrobras.

Let us hope that the social planners in Brazil are more amenable to reason than their counterparts in Caracas have been. ✦

uted $385 billion to the domestic economy in 2008 and more than $180 billion in labor income alone, they noted.

"The influence of the natural gas industry on the economy is spread throughout the continental United States," the report said. "In 2008, more than 30 states had at least 10,000 direct, indirect, and induced jobs related to natural gas."

It said that 2.8 million jobs could be attributed to the gas industry, more than 622,000 of the directly, while another 2.2 million positions were either indirectly related or induced by the industry's economic impact. The number of jobs increased 17% from 2006 to 2008, with direct employment climbing by more than 100,000 jobs and total employment increase by more than 400,000, it said.

The American Petroleum Institute released a study by PriceWaterhouseCoopers on Sept. 9 which found that the US oil and gas industry supports more than 9 million American jobs and contributed more than $1 trillion, or 7.5%, to the gross domestic product in 2007, the most recent year for which data were available.

By comparison, an October 2008 report which Global Insight produced for the US Conference of Mayors found a total of 127,246 US renewable power generation jobs, ANGA indicated. It said that a February 2009 report by the National Mining Association found that the coal industry employs 122,930 people directly and supports 555,650 other jobs, while the Clean and Safe Energy Coalition has said that there are 100,000 nuclear jobs in the country.

"The natural gas industry already provides millions of jobs to Americans, and as Congress seeks solutions to climate change and energy security, it is critical to [provide further incentives for gas], a low-emission fuel source of which the US has a 100-year supply, to help carry America into a new, green, energy independent future," ANGA Chairman David A. Trice said. The group represents 28 of the leading US independent gas producers. ✦

NPC to study transport fuels, oil and gas resources

Nick Snow
Washington Editor

US Energy Secretary Steven Chu would like the National Petroleum Council to conduct studies on future transportation fuels and on prudent development of North American oil and gas resources, NPC members learned at their Sept. 17 meeting.

"It is the policy objective of the United States to protect our nation from the serious economic and strategic risks associated with our excessive reliance on foreign oil and the destabilizing effects of a changing climate," Chu said in a Sept. 16 letter to NPC Chairman Claiborne P. Deming, who also is chairman of Murphy Oil Corp.

"All energy uses and supply sources must be reexamined in order to enable the transition toward a lower carbon, more sustainable energy mix. Transitions in the energy sector will require the replacement of vehicles, more efficient buildings and industrial facilities, and large-scale deployment of new forms of energy," the secretary continued.

For the future transportation fuels study, he asked the council to analyze US auto, truck, air, rail, and waterborne transport fuels prospects through 2030. "The study should address fuel demand, source, manufacturing, distribution, and infrastructure," he indicated.

"Of particular interest is the council's advice on policy options and pathways for integrating new fuels and vehicles into the marketplace, including infrastructure development. Factors to consider include technological advances, market dynamics, environmental mandates, cost/benefit tradeoffs, and impacts on land and water use," Chu said.

For the North American resource development study, he asked NPC to reassess the production supply chain and infrastructure potential, and the contribution that gas can make in a transition to a lower-carbon fuel mix.

"Your study should describe the operating practices and technologies that will be used to minimize environmental impacts, and also describe the role of technology in expanding accessible resources," Chu said. "Of particular interest is the council's advice on policy options that would allow prudent development of North American natural gas and oil resources consistent with government objectives of environmental protection, economic growth, and national security."

He said he was designating Deputy US Energy Secretary Daniel B. Poneman, who addressed NPC at its meeting, to provide the necessary coordination between DOE and the council, as well as provide coordination with the US Departments of the Interior and Transportation, Environmental Protection Agency, and other federal departments and agencies as required.

In other actions, NPC membership reelected Deming as chairman and Chevron Corp. chief executive David J. O'Reilly as vice-chairman for 1-year terms. ✦

NGC prefers full fuel cycle approach to costs

Nick Snow
Washington Editor

Members of the Natural Gas Council would like the administration of US President Barack Obama to adopt a full fuel cycle approach to keep energy costs low and reduce emissions instead of spending $520 billion on recommendations in a recent McKinsey & Co. study.

The study, "Unlocking Energy Efficiency in the US Economy," and its recommendations were based on flawed methodology that did not accurately capture energy lost during its production and transportation, NGC officials said in a Sept. 16 letter to McKinsey officials.

"While the report highlights the potential to achieve significant savings in US energy consumption, we respectfully submit that its value as a blueprint for a comprehensive national energy strategy is undermined by its exclusive focus on end-use, or site, energy savings, rather than a full fuel cycle analysis of the potential to save energy," they said.

The full fuel cycle approach considers the amount of energy produced and lost from the point of its production to the final point of use, according to the NGC. Consequently, it provides a more precise measurement of energy efficiency and environmental impacts than the method use in "Unlocking Energy Efficiency," which only considered energy used at the site, it said.

NGC leaders pointed to a recent Lawrence Livermore National Laboratory analysis that indicated the US could gain energy savings from capturing "rejected energy," such as waste heat from electric power plants, which could warm buildings or turn turbines to generate additional electricity—and do so at lower costs.

This analysis said 75% of the rejected energy associated with residential, commercial, and industrial sectors occurs before end-use applications, the NGC officials said. That type of significant energy impact led the National Academy of science to recommend in May that the nation move toward a full fuel cycle measurement of energy consumption for assessing national and environmental impacts, they added.

NGC provides a forum for leaders to discuss the removal of impediments to producing, processing, transporting, distributing, and consuming gas. ✦

Work flow reveals fault complexity

Jonathan C. Evenick
BP America Inc.
Houston

An effective quality control work flow using basic fault scaling relationships and distributions can help interrogate mapped prospects or appraised fields.

Using displacement-length and cumulative frequency plots, in conjunction with fault seal information, it is possible to rapidly determine if an appropriate level and amount of plausible faults have been mapped in an area of interest. Plotting fault attributes for a field may reveal anonymous curves or gaps that can signify missing faults, noncritical fault mapping, inappropriate fault linking, or interpreters mapping at different scales.

The advantages of this work flow are that it will reduce the time required to effectively map the structural complexity needed to appraise a target, provide an estimate of total number of mappable faults, assess the quality of currently mapped faults, and approximate the number of unmapped faults in areas of poor data.

Scaling and frequency

Faults that form via similar processes often appear very similar over several orders of magnitude (Fig. 1).

Fault-size distribution and scaling relationships, therefore, have been thoroughly documented over many orders of magnitude[1] in different rheologies[2] and faults types,[3] but no definitive correlations have been established. Recent studies have accounted for scaling relationship discrepancies and noted mechanical stratigraphy, seismic resolution, fault linkage, and fault reactivation as sources of potential error.[3-5]

The general fault scaling relationship is $D = cL^n$, where D is maximum displacement, c is a constant that is related to rock strength, L is length, and n is a scaling factor.

Most studies have concluded n is between 0.5 and 2. The exact value is not considered significant to the work flow proposed because the resolution and uncertainty involved with mapping faults in seismic data will produce a certain amount of data scattering. As long as the fault data plot is within general scaling relationships (Fig. 2) the fault is considered possible, but not necessarily correctly mapped.

Cumulative frequency plots of fault data have also previously been shown to correlate well over several orders of magnitude and provided a good ap-

RELAY RAMPS HAVE SIMILAR CHARACTERISTICS OVER NUMEROUS ORDERS OF MAGNITUDE

Fig. 1

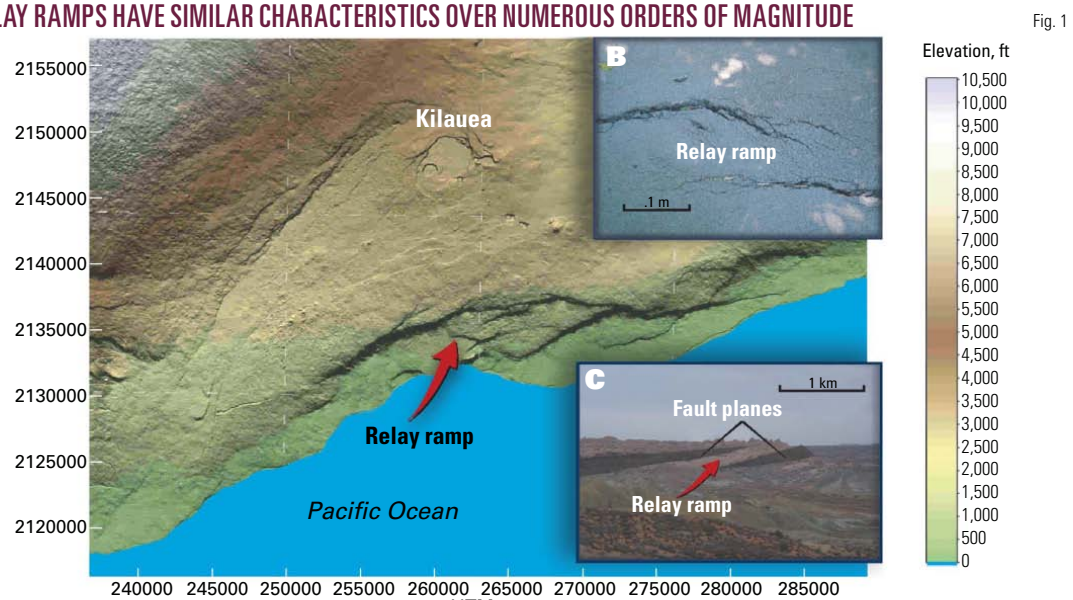
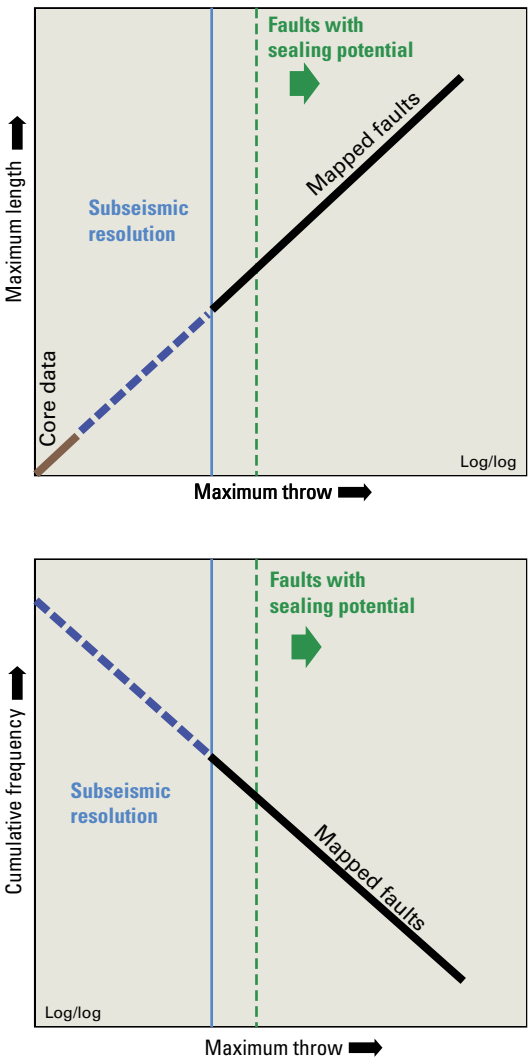


Figure illustrates similar structures over approximately six orders of magnitude. A) DEM of linked normal faults in the Hilina fault system (Hawaii Volcanoes National Park, Hawaii); B) Relay ramp in asphalt (Knoxville, Tenn.); C) Relay ramp along the Landscape Arch trail, (Arches National Park, Utah). For detailed interpretation of the Hilina fault system, see Peacock and Parfitt, 2002.

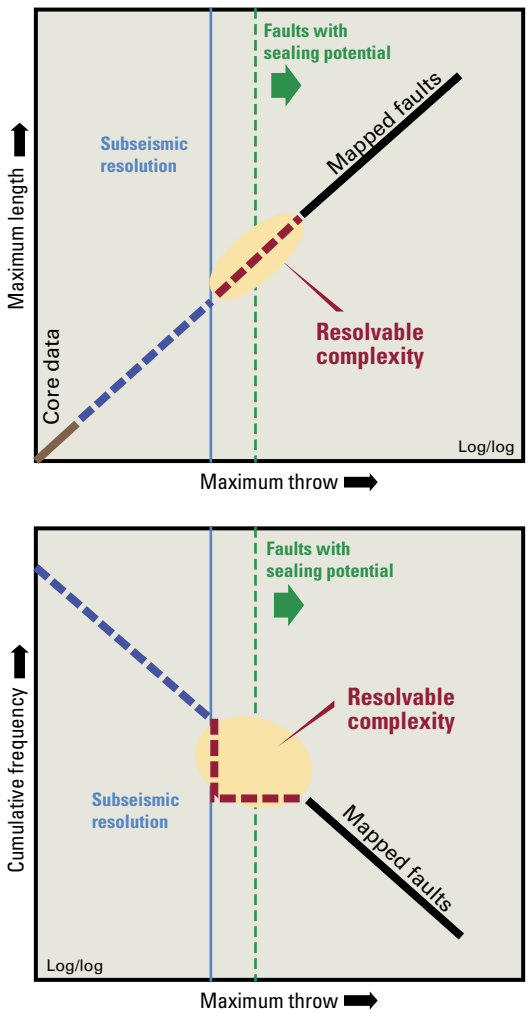
Scaling relationships

Fig. 2



Identifying missing fault complexity

Fig. 3



The identified complexity is above seismic resolution and could be resolved. The data should be further mapped and interrogated because a substantial number of sealing faults are not defined.

proximation of potential fault complexity.[6-9] These plots allow for visual display of anomalous faults or distributions.

Interpreting these plots, along with fault length-displacement plots, has significant quality control potential even if there are not enough faults mapped to derive reliable missing fault complexity or estimates.

Work-flow methodology

Faults and key horizons in a given seismic volume or dataset must first be mapped as accurately as possible, and particular attention must be paid to how faults linked. If faults are hard-linked then it may be appropriate to signify those planes as one fault even though it would be more geologically accurate to have two faults represented.[3-5]

Fault linkage has important implications on fault seal and seal capacity studies, and from these studies the minimum throw of a fault with sealing potential can be estimated and noted. The seismic volume or datasets resolution should be also represented on the fault attribute plots in order to convey quality data and the amount of complexity captured in an interpretation.

Ideally, the majority of mapped faults would not be laterally restricted,[5] whereas their length-displacement relationship would be skewed. Other fault displacement assumptions must also be made in order to derive fault length-displacement relationships.

Since fault throw is easier to quantity than fault length, and maximum displacement rarely is captured in a given horizon map, the maximum throw at a particular horizon will be used in this work flow.

Given fault length is less constrainable due to the inability to accurately map fault tips,[9] there will be a tendency for the data to have some spread. Therefore, fault length-displacements plots should use scaling brackets to

show the likely limits of plausible faults.

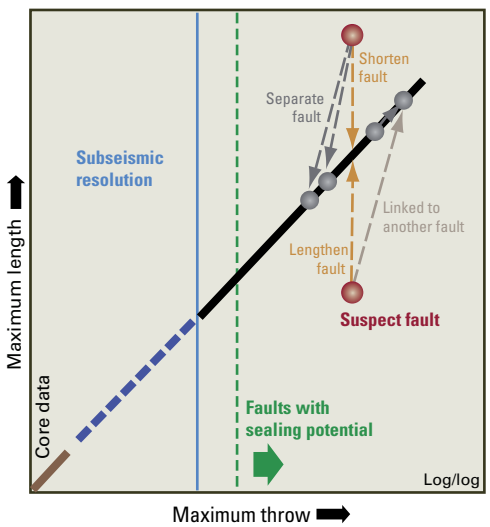
This article will use a general fault scaling relationship of D = Lx, where x is between 10 and 100. Faults that lie outside this range on a log/log plot of maximum throw versus length should be further scrutinized. Further analysis of fault distributions can then be undertaken after anomalous faults are examined and remapped if needed.

Cumulative frequency plots are created by first calculating the number of faults that fall within specific, user-defined intervals and then adding the cumulative number of faults greater than or equal to the lower number in the interval. For example, if one fault has a displacement within the largest interval and eight faults fall within the next largest interval, the cumulative frequency would be one and nine, respectively.

After both plots (cumulative frequency and displacement length) are generated for a mapped interval or horizon, it is highly beneficial to attempt to perform quality control on either particular faults or distributions until both plots qualitatively look acceptable. This iterative process can take significant time if the initial interpretations are poor or if multiple interpreters have mapped portions of the dataset.

IDENTIFYING SUSPECT FAULTS

Fig. 4



Adjusting a fault's length or linkage can move the ratio back into a desirable scaling window. Since fault throw is commonly better constrained than fault length, it is not advised to alter the throw, but sometimes that will also be needed. Cumulative frequency plots of the same dataset will help resolve possible systematic linkage and throw discrepancies.

Some interpreters tend to link overlapping faults ("clumpers") and others prefer to map discrete fault segments ("splitters"). If this is the case, fault throw-length plots may appear good, but the cumulative frequency plot would show two distinctive high sections.

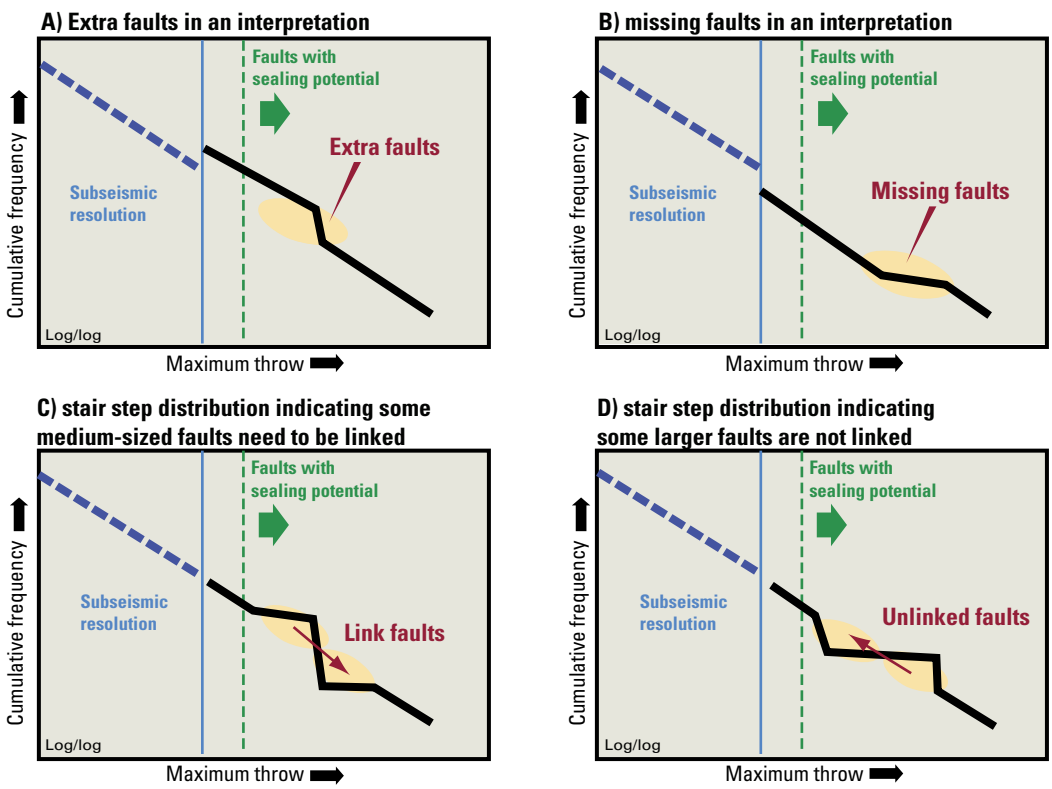
Fault attribute plots

With high resolution data and a considerable amount of time, it is possible to map every resolvable fault in the dataset and produce a highly accurate map and fault framework. The utility of such an endeavor, however, would be highly questionable.

At a certain stage during the mapping process there comes a point of diminishing returns. If the interpreter has adequately captured the complexity needed to assess a prospect, which is commonly when all faults with sealing potential are mapped, then

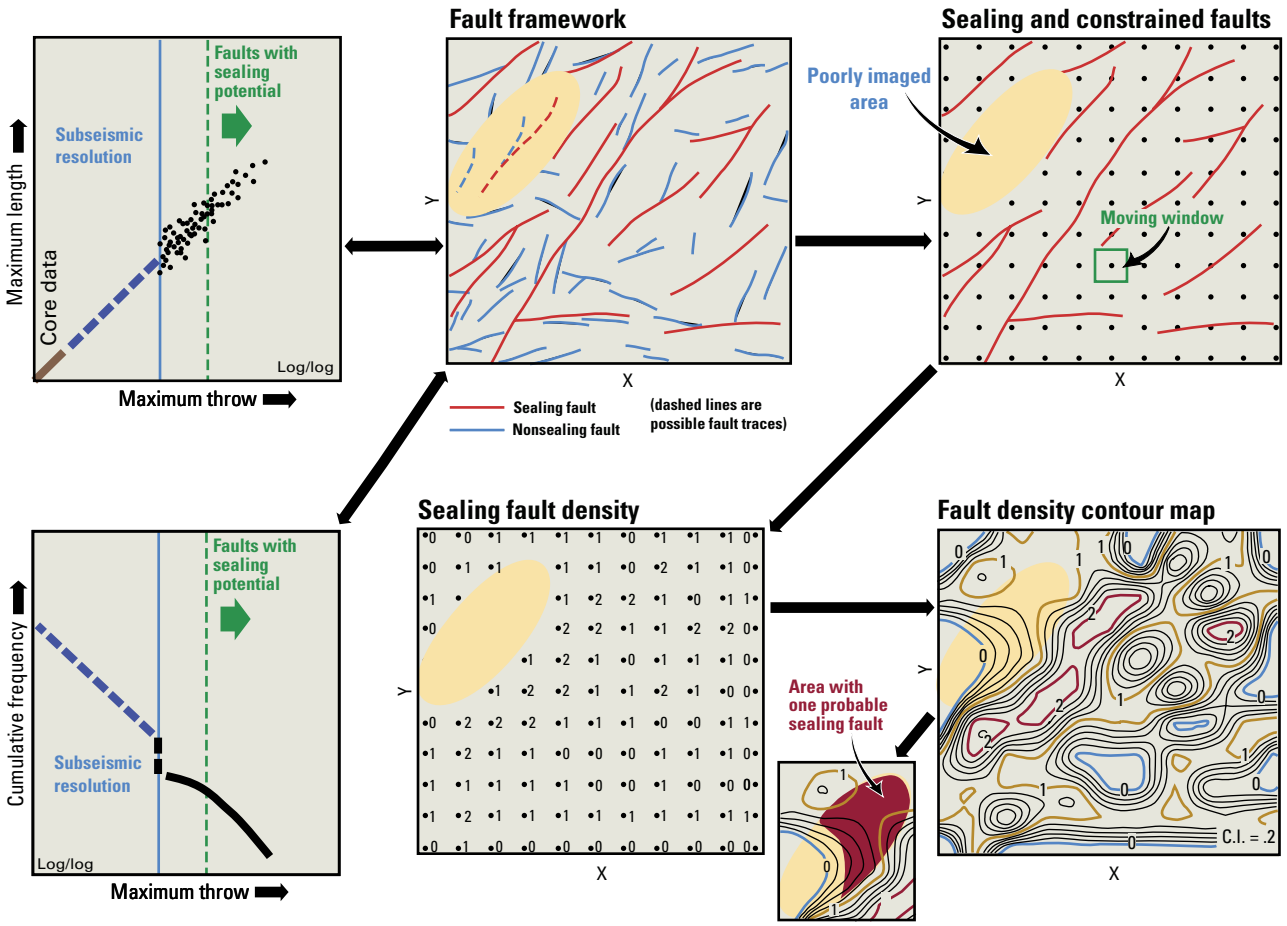
TYPICAL CUMULATIVE FREQUENCY-MAXIMUM THROW PLOTS

Fig. 5



Work flow for evaluating the fault complexity captured in a fault framework or interpretation

Fig. 6



Mapped faults fall within typical scaling relationships and an appropriate level of mapping has been achieved as indicated in the cumulative frequency plot. A fault density map was then created using only faults with sealing potential. An interpolated fault density map was then generated to approximate the number of faults with sealing potential in an area of poorer data.

the mapping of smaller faults can be concluded.

Flow baffles or smaller faults are important to model and capture but are not critical at this stage of exploration. To make reservoir modeling programs work faster, small faults are commonly removed and transmissibility factors are incorporated into the geocellular grids to capture these heterogeneities.

All the mappable faults with sealing potential are commonly not captured because it is difficult to decide how small of a fault is significant (Fig. 3). If the cumulative frequency line starts to flatten out before crossing the estimated throw of faults with sealing potential, then mapping should be continued.

Using attribute plots iteratively while mapping will help address this issue and also designate anomalous faults that ought to be revisited and potentially revised (Figs. 4 and 5).

Another utility of characterizing the potential amount of complexity missing in a given interpretation is the areal density of significant faults can be interpolated[9] across areas of poorer data quality (Fig. 6). Using a moving window, it is possible to estimate the number of faults that intersect that window.

The number of faults is then assigned to corresponding node in the middle of the moving window. The nodes in the area with poorer data can then be omitted and an interpolated grid can estimate the number of faults that may be present in this area as long as there are no gridding problems or artifacts (i.e., the node spacing is too spaced or the poor data area is on a grid edge).

Further estimates can be made from a fault density map if the cumulative frequency plot denotes a certain number of faults are missing from an interpretation. The number of missing faults can be applied or added to the density map to help assign the risk associ-

ated with prospecting in a particular region.[9] Under ideal circumstances, a fault density map should be completed after the fault framework is finalized to an appropriate level.

This article presents a quality control work flow that incorporates well-established fault attribute correlations (fault length displacement and cumulative frequency plots) to interrogate mapped prospects. Using this work flow it is possible to:

- Assess a fault interpretation.
- Determine the level of mapping currently captured.
- Determine if more detailed mapping is needed.
- Estimate fault density in areas of poor data.
- Determine how much fault complexity may be missing.

Acknowledgments

Thanks to BP for the opportunity to publish this work, and thanks to Pablo Cervantes and Jaime Martinez for discussions regarding mapping work flows and effective modeling practices. ✦

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Armstrong gauges Williston basin Lodgepole find

A group led by Armstrong Operating Inc., Dickinson, ND, gauged the Dickinson area's first Mississippian Lodgepole oil discovery since the late 1990s and plans to drill at least one offset.

Armstrong's Laurine Engel-1, in 17-139n-96w, Stark County, flowed 463 b/d of oil at 650 psi flowing tubing pressure from 10 ft of perforations. TD is 9,754 ft.

Armstrong, Continental Resources Inc., Enid, Okla., and Jordan Oil & Gas Co., Healdsburg, Calif., control 1,500 gross acres (1,200 net) offsetting the discovery that has potential for more wells.

A play for oil in Lodgepole carbonate mounds flared in this part of the Williston basin in the 1990s after an initial pool discovery in Dickinson field by the former Conoco Inc. in 1993 (OGJ, Aug. 14, 1995, p. 50). Cumulative production totals 55 million bbl of oil and 28 bcf of gas from 41 wells in the greater Dickinson area. ✦

Ecuador

Drilling can be expected to start within 2 months at giant Pungarayacu heavy oil field on Block 20 in Ecuador, said Ivanhoe Energy Inc., Calgary.

The deepest wells will go to no more than 1,500 ft.

Consulting engineers reviewed data from 27 wells Petroproduccion drilled in the 1980s and estimated the original oil in place range at 4.3-12.1 billion bbl with a most likely 6.4 billion bbl. At Ivanhoe Energy's request, a recovery factor was not estimated.

Crude oil gravity in the 250 sq mile field is commonly held to be 10-11° gravity, but Ivanhoe Energy said it has geological indicators that the oil might be lighter than that.

Kenya

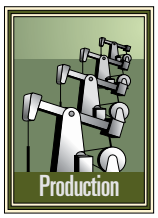
China National Offshore Oil Corp. plans to spud the Bogal-1-1 exploratory well on Block 9 in Kenya's north-central Anza basin at the end of October 2009, said Africa Oil Corp., Vancouver, BC.

The well will target Jurassic reefal limestone and Cretaceous sandstones with a projected total depth of 5,000 m. Numerous other prospects have been identified.

Interpretation of reprocessed vintage seismic data from Africa Oil-operated Block 10A is under way. The new data provide a clearer image of vast subbasins on the block. To supplement the existing data, 750 line-km of new 2D seismic will be shot.

Reverse osmosis treatment of CBM produced water continues to evolve

James Welch
Siemens Water Technologies
Houston



A comparison of two treatment plant designs shows the evolution of the reverse osmosis process for treating produced water from Powder River basin coalbed methane wells.

Both designs incorporate reverse osmosis (RO) and recovery reverse osmosis (RRO) because this configuration has proven effective for meeting produced water treatment objectives.

Each year US oil and gas onshore operations generate about 15-20 billion bbl of produced water. By comparison, the Wyoming, Powder River basin produces between 700 and 900 million bbl/year of water from natural gas wells.

CBM production

Coalbed methane recovery techniques are unique when compared with other production methods because hydrostatic pressure holds the methane in the coal seam so that gas production requires removal of formation water or dewatering.

Removing the formation water depressurizes the formation, thus releasing the gas. Initial water production is high but decreases rapidly to allow release of the methane.

Producers must manage these considerable volumes of water generated during the dewatering process. Much of the water can be disposed of by direct discharge given the high quality of the CBM produced water in the Powder River basin.

Operators must manage produced water of a lower quality, however, depending on environmental compliance and economic objectives. This would include volume of produced water, proximity to surface water, rights-of-way, influent chemistry, discharge quality requirements, land use provisions (public or private) and recycle objectives.

The reverse osmosis RO-RRO process has been permitted through the Wyoming Department of Environmental Quality/Water Quality Division (WDEQ) Chapter 3 process, requiring review and monitoring by the department's water and waste water division engineers.

Both plants minimize waste by

The produced water stream enters a ballast pond before being pumped to the Wild Turkey treatment facility (Fig. 1).

maximizing system recovery, and use an aeration pond for evaporating and concentrating the brine (Figs. 1 and 2). The plants include a design with bypass and blend provisions so that the plants can blend the produced water to a wide range of discharge specifications.

Both plants maximize membrane performance with filtration and scale control, but differ in the approach to controlling scale (Fig. 3). It is the nature of the scale control that is the primary focus of this article.

The article also will discuss selected components of the treatment process for each plant and lessons learned as the plant design matured with treatment experience and the producer's needs.

Waste water from the Wild Turkey system goes to evaporation ponds (Fig2).

Influent, effluent criteria

One must clearly understand feedwater characteristics for proper treatment plant design. This includes seasonal variability that may identify influent extremes or complex chemistries. Waste and product stream characteristics must also be understood so that service factor, redundancy, and compliance can be addressed in the plant system design.

By its inherent nature, CBM water is high in sodium and bicarbonate and low in hardness, and may also include suspended solids, iron, silica, and barium.

Sodium is a closely monitored aspect of the treatment plant effluent. Soils with an excess of sodium ions, as compared to calcium and magnesium ions, can affect the way plants adsorb water. The ratio of the sodium to calcium and magnesium is referred to as the sodium adsorption ratio (SAR).

The plants also require Wyoming Pollutant Discharge Elimination System (WYPDES) permits issued by the Wyoming DEQ for construction, operation and discharge of the produced water. The plants can discharge greater than 95% of the influent water into the Powder River.

The state permitting authority defines effluent standards to protect aquatic life and downstream uses of the water. The treatment systems have sufficient flexibility to meet the defined

effluent recipe as it changes on a monthly basis.

Application engineers use solubility indices to understand the relationship of the dissolved ions as they move through the treatment process. For instance, one technique for predicting calcium carbonate solubility considers the bicarbonate carbonate and calcium concentration to access the potential for hardness scale formation.

This is the concept behind the Langelier saturation index (LSI). A positive LSI denotes an increased potential for calcium carbonate scale formation while a negative LSI denotes that calcium carbonate may dissolve in the solution.

The Wild Turkey plant RO-based treatment system prepares the water for surface discharge (Fig. 3).

LSI is one of the many solubility indices that facilitate design engineers' understanding of ion interactions as water chemistries change through a process. This information helps designers control the severity of the process and applies appropriate equipment and chemistries to moderate the behavior of the water as it progresses through the process.

Another constituent common in CBM water is silica. Because of its unique chemistry, silica poses special treatment challenges to design engineers. While the silica concentration in Powder River basin produced water is moderate, the high recovery rate of the membrane system creates ideal conditions for silica to scale membrane surfaces. Silica precipitation control is complicated further because control techniques for other ions conflict with methods for controlling silica.

Geographical, environmental concerns

The Powder River basin is a sparsely populated region, and unlike water treatment plants in industrial or municipal applications, the plants have intermittent manpower coverage. This must be considered when designing the system to ensure sufficient redundancy to address uptime and reliability objectives. Key considerations include redundancy, call-out features, response time, and safety.

The two treatment plants discussed in this article are in the Powder River basin. Given the potential for inclement weather, inventory controls must incorporate the possibility for restricted site access during seasonal extremes.

One must carefully design acid feed systems to minimize risks to personnel and facility. The volume of hydrochloric acid needed to neutralize the alkalinity inherent in the CBM water is considerable.

Tanker trucks deliver the acid, often down lease roads and potentially during severe weather. The facility should:

- Store the acid outdoors in double-contained tanks.
- Have double-contained feed lines and valves.
- Locate tanks as close as possible to injection points to minimize the feed line length.

Another key criterion in system design is meeting discharge specifications to comply with WDEQ specifications for protecting aquatic life from toxicity. The test commonly used to confirm compliance is the Whole Effluent Toxicity Test, or WET test.

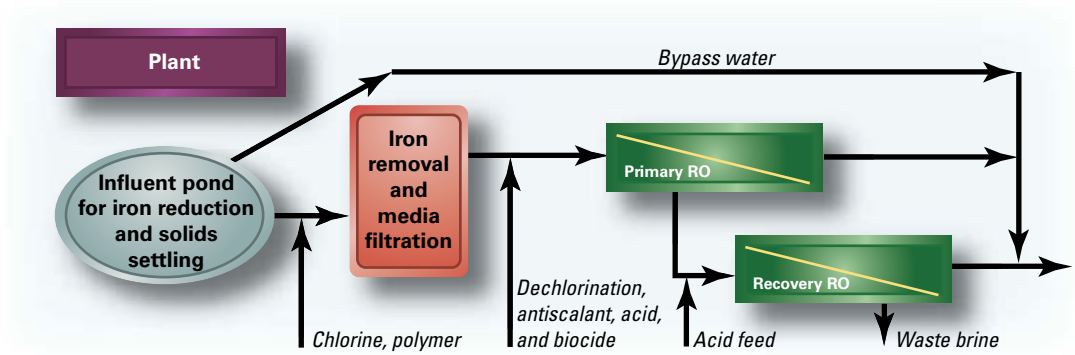
The test involves collecting effluent samples at appropriate outfalls and analyzing them to determine the effect of the discharged water on aquatic life in the receiving waters.

The acute WET test is a 48-hr static test using daphnia magna (water flea) and an acute 96-hr static test using pimephales promelas (fathead minnow), as collected from designated outfalls.

Toxicity occurs if mortality exceeds 50% for either species at the effluent concentrations. Chronic WET testing is

WILD TURKEY PLANT

Fig. 4



a 7-day test using pimephales promelas. The test requires collecting a series of composite samples during several days.

The test dilutes the subject water with synthetic lab water to evaluate the degree of toxicity as compared to the lab control sample.

First plant

The first CBM treatment plant installed by Siemens for Petro-Canada Resources (USA) was at the company's Wild Turkey operations near Gillette, Wyo. The plant, commissioned in 2006, has a design for processing 120,000 b/d of produced water at peak production and discharging treated water to a Powder River tributary.

The plant's design allows for the discharge to have a blended sodium level and to meet WET standards. Fig. 4 shows a schematic of the plant.

Because Petro-Canada was eager to start processing the produced water as soon as possible, the project involved placing a temporary mobile treatment system online during the installation of the permanent system.

The mobile system components included media filtration and RO skids. The skids were contained in fully automated trailers that included instrumentation and climate control. Siemens personnel located onsite operated and maintained the application with support and critical spares sourced from the Siemens Colorado Springs, Colo., branch office.

Second plant

In 2008, Petro-Canada awarded Siemens a second operating contract for the treatment of Powder River basin CBM water at Mitchell Draw, also near Gillette. As of the date of article, the company has not commissioned the plant. The plant has a design for treating 72,000 b/d.

The Siemens engineers wanted to advance the Wild Turkey plant design by focusing on hardness and silica scale formation and acid feed.

Borrowing on capabilities introduced by DOW in 1983,[1] Siemens added ion exchange softening into the process flow as a key innovation over the Wild Turkey design. Ion exchange removes polyvalent cations from the feedwater. The process removes constituents such as calcium, magnesium, barium, and soluble iron to very low levels by exchanging them for sodium on the ion exchange resin.

On first review, adding a strong acid cation sodium-form softener may not be an obvious addition because sodium is a strictly controlled effluent contaminant. The amount of calcium and magnesium in the CBM water relative to the amount of sodium, however, is low, so that the percentage increase in the amount of sodium is low.

The softener provides several advantages. First, it reduces the potential for scale formation by removing dissolved cations such as calcium, magnesium, and barium. This reduces the antiscalant and acid chemical requirement typically used for controlling solubility when influent concentration or system design affects the solubility limits.

The Mitchell Draw plant will operate at a higher pH than the Wild Turkey plant. As stated previously, the process typically feeds acid to a neutral or slightly acidic pH range to control hardness scale. Without acid feed, the bicarbonate alkalinity concentration increases, resulting in an alkaline feedwater condition.

The higher pH offers preferred operating parameters that increase the solubility of residual organics, thus reducing the potential for organic fouling on the membrane surface. The higher pH shifts the boric acid to borate equilibrium so that the membrane more easily rejects the boron, resulting in lower boron concentrations in the effluent water. The higher pH increases silica solubility, thus lowering the potential for silica fouling.

Fig. 5 shows a flow schematic of Mitchell Draw.

Lessons learned

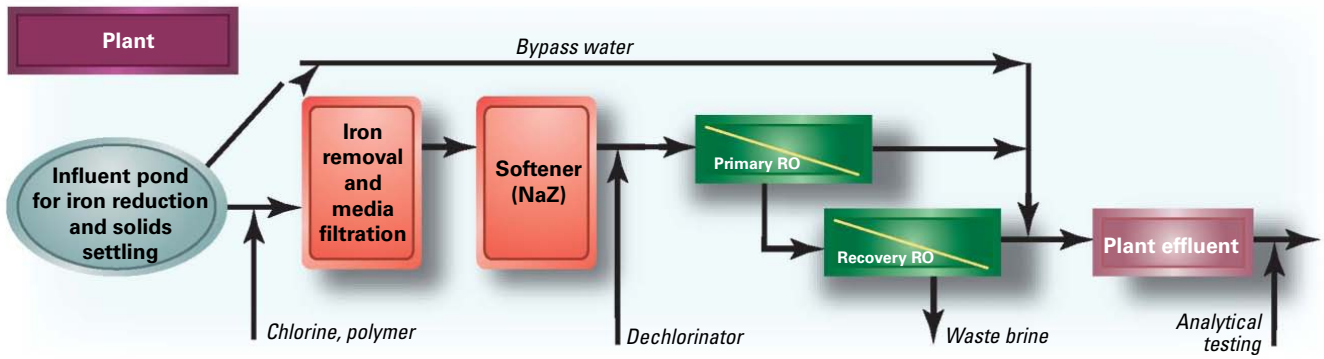
The Wild Turkey treatment system was a success because it provided the intended recovery rate, was reliable, and handled changing effluent water standards. The system design followed a conventional approach including influent settling, media filtration-iron removal, acid feed, and RO.

Because disposal cost is a primary driver for produced water projects, the process met this objective by maximizing system recovery to minimize brine disposal costs.

Managing the soluble iron was one of the challenges addressed by the design engineers. Iron and other soluble metals can oxidize within the membrane modules and foul the mem-

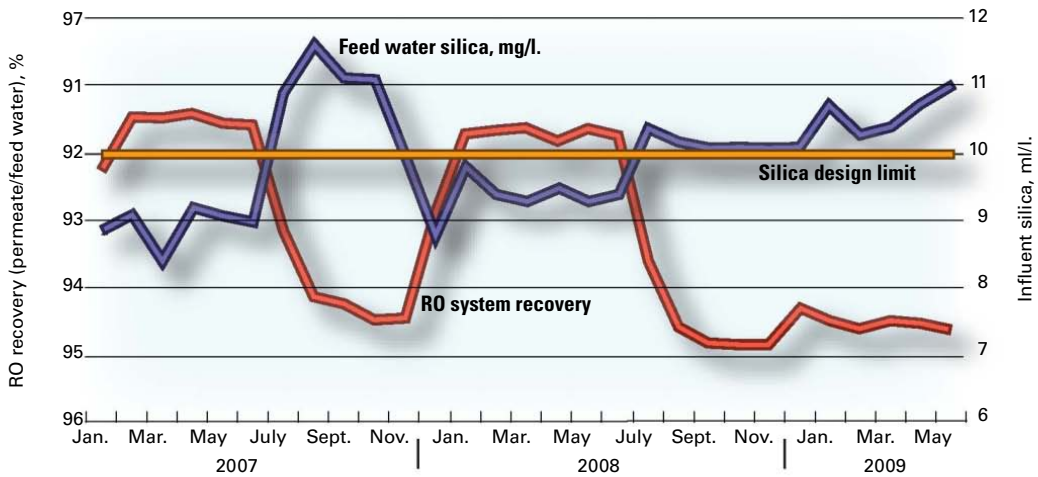
MITCHELL DRAW PLANT

Fig. 6



WILD TURKEY PLANT PERFORMANCE

Fig. 6



branes, resulting in reduced performance.

Wild Turkey produced water averaged greater than 10 ppm; however, it is not uncommon for Powder River basin CBM water to contain 20-30 ppm of dissolved iron.

On initial inspection, iron-laden produced water may appear clear, but as the water is exposed to air and the iron oxidizes, the water takes on a rust color and becomes more turbid, representing increased loading for media filters and potential fouling of the membrane systems.

Petro-Canada addressed the soluble iron problem by installing a "riprap" system, which is commonly installed to control bank erosion. This application allows the influent to cascade over coarse stones to oxygenate the water and thus oxidize the iron prior to entering the influent equalization basin. As a precautionary step, the process adds chlorine to oxidize further the soluble iron. This process successfully converted the iron to an insoluble form that the iron removal filtration media could eliminate.

The Wild Turkey plant configuration addressed the dynamic operating conditions because produced water systems do not operate at steady-state conditions. As defined by the discharge permit, effluent standards change monthly so as to limit the sodium loading into the receiving water.

A second challenge was the changing influent silica concentration. Silica is a primary factor affecting system recovery for membrane systems. In the Wild Turkey plant, influent silica fluctuated between 8 and 12 ppm, which resulted in a corresponding fluctuation in RO recovery, between 92% and 96% (Fig. 6).

The following factors affected system productivity:

- When influent silica concentration was above design peak, RO system recovery was reduced.
- Silica concentration in brine needs to be limited for sustainable RO membrane performance.
- Antiscalant may not protect against silica scaling above a certain level.
- Silica levels appear to vary over time, either seasonally and/or with extended production from the CBM wells.

The Wild Turkey plant design addressed dynamic influent and effluent conditions. Key to this capability was the excess capacity on the RO system and control strategies that optimized the system configuration.

Acid feed control was vital for reliable operations of the Wild Turkey plant. Failure to control properly acid addition can result in scale formation

FEED CHEMISTRY

Feedwater	Units	pH-adjusted feed — Feed	pH-adjusted feed — Adjusted feed	Softened feed — Feed	Softened feed — Adjusted feed
Potassium	mg/l.	35.2	35.2	35.2	35.2
Sodium	mg/l.	880.0	880.0	880.0	940.9
Magnesium	mg/l.	14.6	14.6	14.6	—
Calcium	mg/l.	28.0	28.0	28.0	0.1
Strontium	mg/l.	0.9	0.9	0.9	—
Barium	mg/l.	1.4	1.4	1.4	—
Carbonate	mg/l.	40.7	2.3	40.7	40.7
Bicarbonate	mg/l.	2,416.0	2,118.0	2,416.0	2,416.0
Chloride	mg/l.	28.4	247.0	28.4	28.4
Fluoride	mg/l.	1.0	1.0	1.0	1.0
Sulfate	mg/l.	1.0	1.0	1.0	1.0
Silica	mg/l.	15.0	15.0	15.0	15.0
Boron	mg/l.	0.2	0.2	0.2	0.2
Carbon dioxide	mg/l.	18.9	262.5	18.9	18.9
TDS	mg/l.	3,463.0	3,345.0	3,463.0	3,479.0
pH		8.2	7.0	8.2	8.2

Scaling calculations		Feed	Adjusted feed	Concentration	Feed	Adjusted feed	Concentration
pH		8.2	7.0	8.3	8.2	8.2	9.5
Langelier saturation index		1.2	–0.1	3.8	1.2	–1.3	2.6
Calcium sulfate	% solution	—	—	0.2	—	—	—
Barium sulfate	% solution	24.6	24.6	532	24.6	—	—
Strontium sulfate	% solution	—	—	0.2	—	—	—
Calcium fluoride	% solution	3.7	3.7	30,251	3.7	—	108.0
Silica dioxide	% solution	11.5	11.5	173	11.5	11.5	83.5
Magnesium hydroxide	% solution	—	—	0.4	—	—	—

on membrane systems. For instance, there was a period in which changing influent conditions resulted in scale formation on piping and the valves between the primary RO and the recovery RO. Increasing the acid dosage to reduce the pH reversed the scaling process.

Mitchell Draw improvements

Siemens expects the following benefits from the Mitchell plant, after it is commissioned.

CBM water is characteristically high in sodium and low in calcium and magnesium hardness. The low hardness concentration makes it an ideal application for sodium-form ion exchange. Removal of the hardness ions reduces the risk of hardness scale formation and the need for acid.

CBM water contains relatively high concentrations of bicarbonate alkalinity. Given the concentration effect across a membrane system, the pH of the feedwater will increase to increase the solubility of silica and residual organics and improve the rejection of boron.

The process eliminates acid for scale control, resulting in improved plant safety and system reliability. The plant does not need trucks hauling acid, thereby removing them from public highways and reducing risks to the plant and personnel.

The new design removes acid feed equipment and controls from the system because pH control is no longer a primary concern to system operation. In addition, it improves system reliability because inventory control is less vulnerable to delivery interruptions.

Water analysis comparison

The table above illustrates the changes to feedwater quality while applying each scale control technique. The feedwater data are approximated from actual Powder River basin produced water analyses. The analyses are then modeled using the Dow Chemical Co.'s Reverse Osmosis System Analysis (ROSA) program to illustrate the changing conditions.

In the pH-adjusted feedwater case (Wild Turkey plant), the process reduces the pH to 7.0 from 8.2 with hydrochloric acid as compared with sulfuric acid, since the sulfate in sulfuric acid can cause scaling as it bonds with divalent cations present in the feedwater.

Acid addition changes the characteristics of the water as hydrogen neutralizes bicarbonate to form carbon dioxide and chloride. This results in a marked increase in chloride concentration from the contribution of hydrochloric acid and a reduction in raw water LSI to –0.1 from 1.2.

In the softened feedwater case (Mitchell Draw plant), the plant reduces the divalent cations calcium, magnesium, strontium and barium to less than 0.3 ppm in the adjusted feedwater. There is a corresponding increase in sodium content as an equivalent amount of sodium is exchanged into the water.

Unlike the acid feed case (Wild Turkey plant), the pH and total dissolved solids (TDS) stay about the same. The LSI scaling calculation shows –1.3 in the adjusted feedwater. Furthermore, the barium sulfate and calcium fluoride scaling calculations also show reduced scaling potential with the softened feedwater case (Mitchell Draw). ✦

Reference

1. Reyes, R.B., "Softening of Oilfield Produced Water by Ion Exchange for Alkaline Flooding and Steamflooding," Paper No. SPE 11706, SPE California Regional Meeting, Ventura, Calif., Mar. 23-25, 1983.

The author

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GAS SHALE—2

Lessons learned help optimize development

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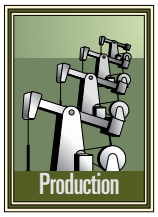


Exploring for resource quality, building advanced technological capability, pursuing improved performance and cost efficiencies, and adopting high-value entry strategies are some factors leading to successful exploitation of gas shales.

Our first article on gas shales (OGJ, Sept. 28, 2009, p. 39) introduced the numerous geological, engineering, and economic challenges facing optimum exploration and development of gas shales, including how operators have addressed and learned from these challenges. This second article pursues these important topics in more depth.

The third and final article in this series will examine emerging shale plays in North America and other settings, as well as environmental challenges facing shale development.

Resource quality

No single factor is more important than rigorously establishing and then capturing the core area of a gas shale basin or play.

Each gas shale play we have assessed has, in general, three grades of resource quality:

1. Compact core sweet-spot area.
2. Reasonably sized average productivity area.
3. Extensive fringe area, often called the goat pasture.

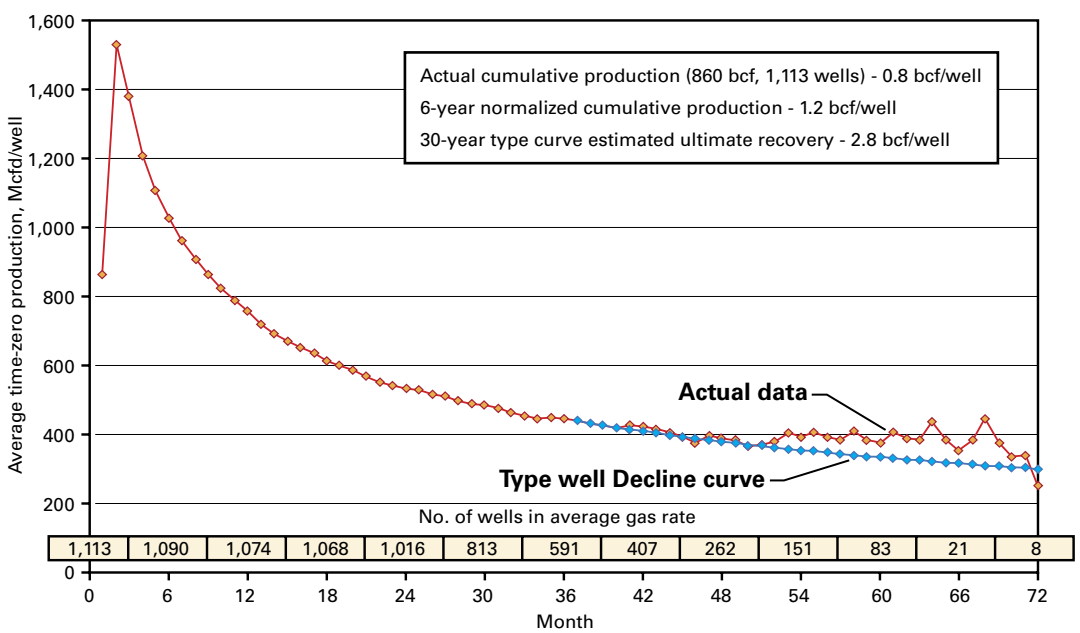
The core area of a gas shale play, with rich resource concentrations of 150-200 bcf/sq mile, provides a massive economic advantage over the fringe area with its much leaner resource concentrations of 50-70 bcf/sq mile.

For example, in the Barnett shale gas play that covers nearly 8,000 sq miles, a quarter of the basin area (the core area) has high resource concentrations and outstanding horizontal wells, with average estimated ultimate recoveries of 2.8 bcf (3 bcfe with NGLs) and much higher recoveries by the best individual wells (Fig. 1).

In comparison, the fringe area contains half of the basin area and has horizontal wells that average about 1 bcfe. Given relatively similar well drilling and completions costs, it is clear why identifying and capturing the core area provides much

BARNETT SHALE CORE AREA HORIZONTAL WELLS

Fig. 1



lower finding and development costs per Mcf and thus major competitive advantage to operators with substantial core area acreage.

Resource settings

High resource quality for gas shales requires the convergence of a series of favorable reservoir properties beyond thick net pay. These include adequate porosity, greater than 3%, and high reservoir pressure, ideally overpressured, to pack more gas into a given volume of shale and keep natural and induced fractures open during early production.

High-quality shale properties also include favorable thermal maturity—vitrinite reflectance (R_o) of 1.5% or greater—to place the shales in the dry gas window and avoid unfavorable relative permeability effects caused by oil blocking the small pore throats and permeability pathways common to many of the gas shale plays. A few combination oil-gas shale plays with higher permeability intervals embedded in the shale matrix do exist, however, such as in the northern portion of the Barnett shale gas play.

The shales require a sufficiently high organic richness (TOC greater than 2 wt %) for generating abundant volumes of gas, some of which is adsorbed by the thermally mature organics.

As introduced in Part 1, adsorptive capacity is most important for shallow gas shales, while porosity becomes the dominant gas storage mechanism in deep gas shales (Fig. 2). While TOC decreases with thermal maturity, the remaining higher maturity organics have high adsorptive capacity, contributing to higher gas in-place concentrations.

In addition, higher thermal maturity shrinks the in-place organics and helps create more pore space for storing gas (Fig. 3). The presence of preserved diatoms in the shale formation also can provide enhanced storage space, accounting for the higher porosity volumes reported for gas shale deposits such as the Haynesville.

An often-overlooked high quality shale property is favorable in situ stress. The in situ tectonic stress of the shale formation influences both the permeability of the formation as well as its response to hydraulic stimulation. Areas with lower and relatively equal horizontal stresses will have higher reservoir flow capacities and will achieve more effective multibranched hydraulic stimulations.

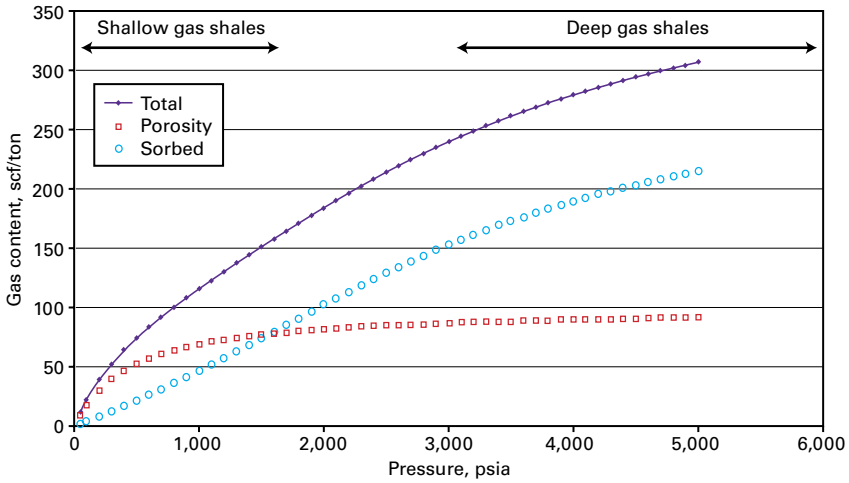
Assessing mineralogy

The mineral composition of the shale becomes important when one evaluates gas shale reservoir properties for quality. While ordinary shales consist predominately of various clays, the deep reservoir-quality shales are dominated by brittle minerals such as quartz, carbonates, and feldspars and are relatively low in clay (<50%). Such silicic shales are brittle and shatter when stressed, providing multiple dendritic fracture swarms.

In contrast, shales with a high clay

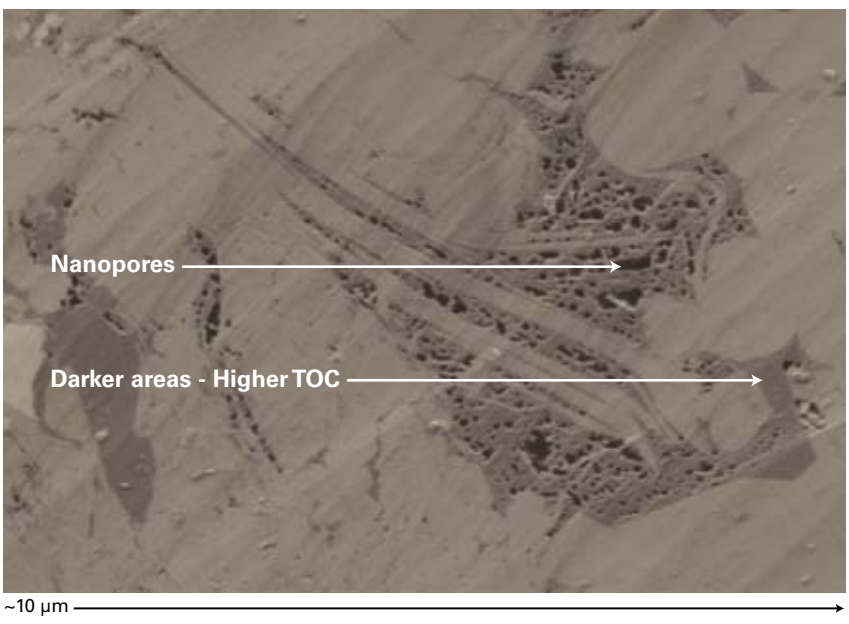
Adsorption isotherm

Fig. 2



Thermal maturity, gas storage capacity

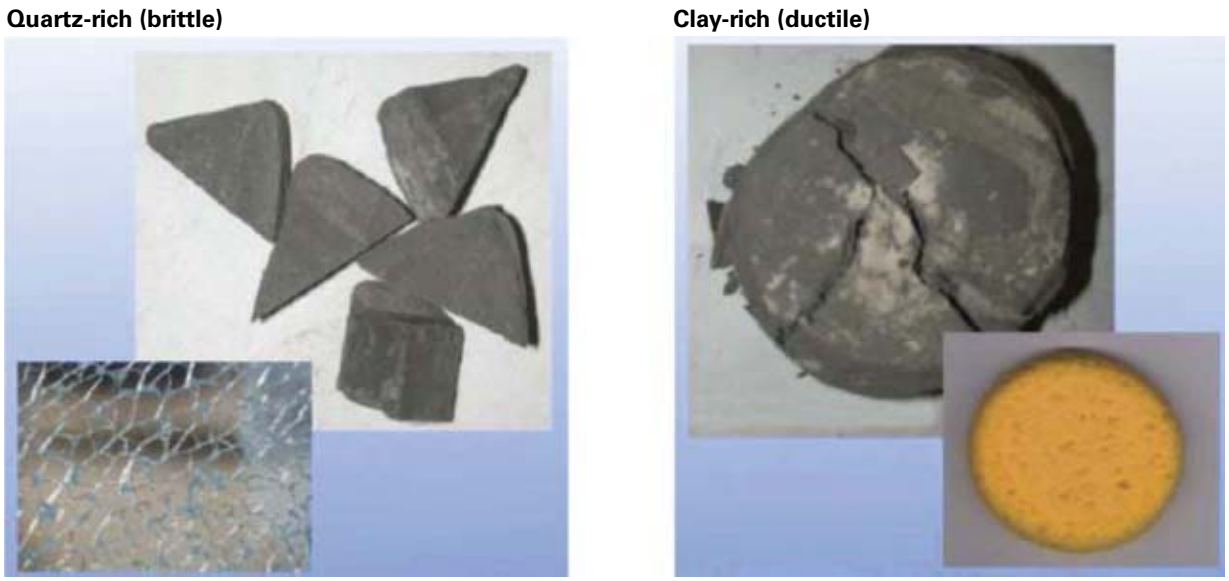
Fig. 3



Source: Reed et al., Texas BEG

SHALE MINERALOGY, STIMULATION EFFECTIVENESS

Fig. 4



Source: CSUG, 2008

content are plastic and absorb energy, providing single-planar fracs.

As shown in Fig. 4, the quartz-rich Barnett shale is brittle and shatters under hydraulic stimulation, creating an extensive area of reservoir permeability. The clay-rich Cretaceous-age shales promote long, single-plane hydraulic fractures that do not.

GAS SHALE HORIZONTAL WELL PERFORMANCE

Table 1

Time period	No. of wells placed on production	Average IP	30th day rate	60th day rate	Average lateral length, ft
		Mcfd			
1st qtr. 2007	58	1,260	1,070	960	2,100
2nd-4th qtr. 2007	197	1,770	1,490	1,290	2,500-3,190
1st qtr. 2008	75	2,340	2,150	1,940	3,300
2nd-4th qtr. 2008	244	2,920	2,480	2,210	3,720
1st qtr. 2009	120	2,990	2,540	2,310	3,870
2nd qtr. 2009	111	3,610	2,950	2,690	4,120

Technological capability

Efficiently pursuing gas shales is a high-tech undertaking, involving production of hydrocarbons that the industry traditionally has viewed as an essentially impermeable source or cap rock. The technological leap that cracked the technological code was the introduction of horizontal drilling supplemented by intensive hydraulic stimulation.

The permeability of the gas shale matrix is low, about a few hundred nanodarcies. Achieving economically attractive flow rates requires drilling long horizontal wells in extensively fractured rock by hydraulics or by nature. As such, the operator is either creating permeability by shattering the shale or linking up native permeability in the rock from small-scale natural fractures.

Considerable discussion has centered on the importance of natural fractures for providing economically viable flow paths in gas shales. Our view is that small-scale natural fractures, essentially microscale, grain-to-grain planes of weakness in the shale matrix, provide enhanced permeability and help create multibranched, orthogonal hydraulic fractures.

In contrast, large-scale natural fractures and faults are, in general, detrimental because they can limit effective horizontal lateral lengths, absorb hydraulic fracture energy and, at times, serve as conduits for water.

Gas shale formations such as the Fayetteville that have been deeply buried and then uplifted, tend to have more microscale planes of weakness due to relaxation of stress and formation cooling during the uplifting phase.

Well productivity

Today's best practices for effective hydraulic stimulation of gas shale formations involve a dozen or more frac stages, closely spaced perforation clusters, and massive injection of energy using large volumes of water and ideally no gels or other formation damaging chemicals.

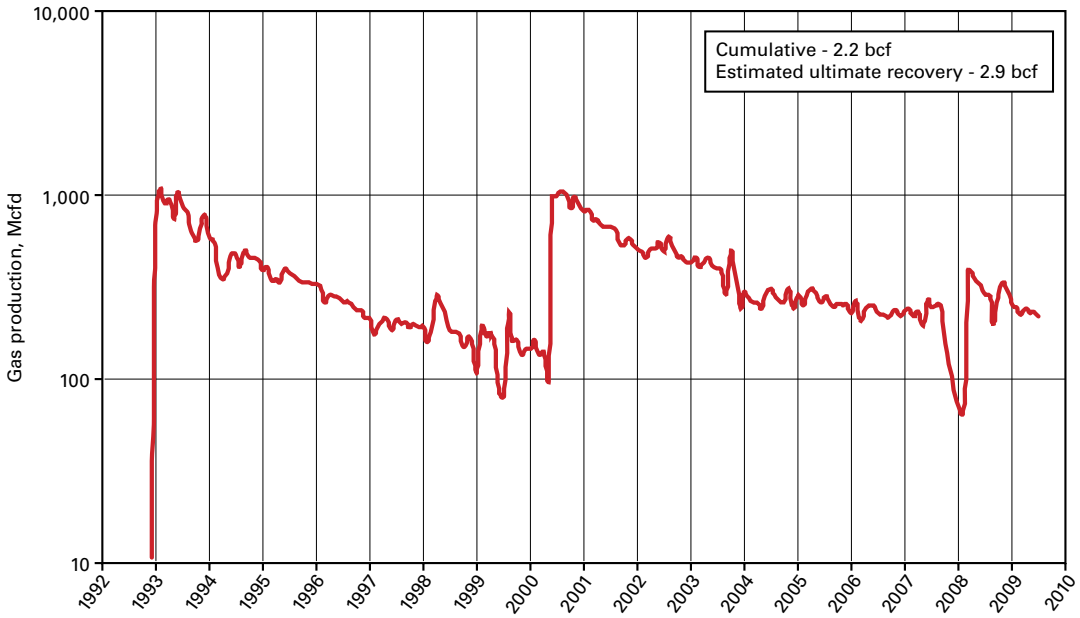
A longer effective horizontal lateral, properly completed and stimulated, will create a larger volume of permeable reservoir (shattered matrix) connected to a wellbore.

As the accompanying table shows, the experience from the Fayetteville shale is that a 100% longer lateral combined with other key design modifi-

cations such as closer perforation clusters, higher volumes of injected energy, and the elimination of crosslinked gels provides a well with nearly three times greater early time productivity. The most recent wells have a 3.61 MMcfd initial potential (IP) and an average 4,120-ft horizontal length compared with a 1.26 MMcfd IP for earlier (first-quarter 2007) wells with a 2,100-ft horizontal lengths.

REFRACED DENTON CREEK TRADING NO. 1 WELL

Fig. 5



Importantly, the longer lateral well maintains its gas rate through at least the first 60 days of production and, based on type curve matching, throughout its full productive life.

In the Woodford shale, operators are testing horizontal wells with up to 10,000 ft of lateral to bring down the unit costs and attempt to make this challenging shale play more economic.

3D seismic

Today, operators are using 3D seismic extensively in the Barnett, Fayetteville, and numerous other shale plays to identify faults and other structural features of importance for designing and locating wells. Seismic also can help orient the azimuth of the horizontal leg to take advantage of stress and permeability anisotropy.

Even at costs of $200,000/sq mile, 3D seismic adds only $25,000 to costs/well (less than 1% of a well's capital expenditure), assuming 8 wells/sq mile.

A challenging technical topic still under development is how might seismic attributes help identify areas of lower stress and higher permeability, the economically attractive sweet spots.

Petrophysics, cores

With shale formations many hundreds of feet thick, choosing where stratigraphically to position the lateral leg becomes key. Detailed analysis of rock mineralogy, TOC, gas shows, and natural fracturing provides initial guidance, later fine tuned by drilling results.

In gas shale plays where the organically rich shale interval is interrupted by a significant zone of nonproductive shale or a frac barrier, dual laterals may need to be drilled from the vertical wellbore, such as being tested for jointly producing the Upper and Lower Montney shale in British Columbia.

Performance assessments

Several successful gas shale operators have established teams with high-level crosscutting technical capabilities. These teams generally located outside the shale business unit provide independent evaluations of how effectively each business unit is adapting and applying best technology and operations practices.

This organizational strategy is similar to the designation of consulting engineers, often the top technical position within the company, that report directly to the vice-president for exploration and production to provide independent reviews and help promote the use of best practices.

Multidisciplinary team

Cost-effective gas shale development requires a multitude of technical skills, including sophisticated reservoir modeling, geomechanics, geochemistry, and petrophysics, along with strong well testing and fracture diagnostics capability.

Our experience is that incorporating geologic, engineering, and operations talents into each business unit and then supplementing these talents with organizationally crosscutting experts, as discussed previously, can accelerate the process for cracking the technical code in each gas shale basin and making progressively better wells.

Continuous learning

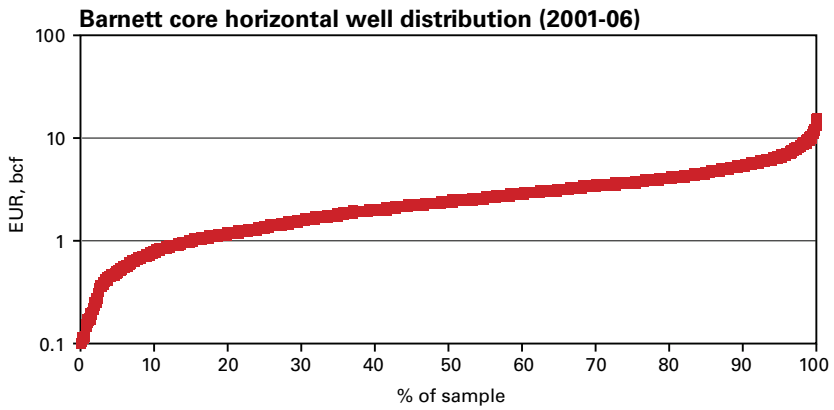
Next to capturing the core areas of the better gas shale basins and plays and developing these areas with best practices technology, no single other factor is

BARNETT EUR DISTRIBUTION

Fig. 6

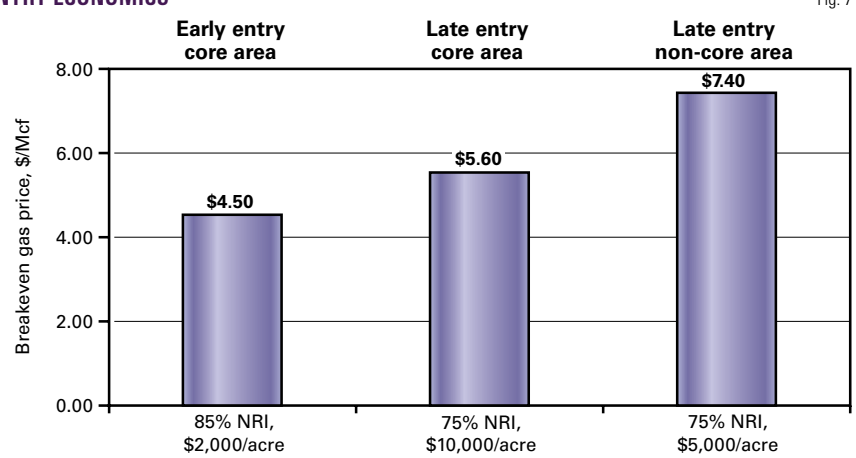
Barnett core horizontal wells

2001-06	Successful wells	EUR/well, bcf	Range	
			Low value, bcf	High value, bcf
10%	108	7.3	5.4	15.1
20%	217	4.2	3.4	5.4
30%	325	2.7	2.0	3.4
40%	434	1.2	0.1	2.0
Total	1,084	Ave. = 2.8		
Dry holes	43			
Well count	1,127			
Success rate, %	96			



ENTRY ECONOMICS

Fig. 7



Note: NRI - net revenue interest. Assumes $3.2 million drilling, completion, and facility costs, plus land, 3 bcfe EUR in core area and 2 bcfe in non-core area, and 15% return on investment.

more important than relentless pursuit of efficiencies and cost reductions.

The fact that the larger shale plays require thousands of shale wells drilled over decades provides opportunity for continuous improvement, unlike conventional offshore development that must get it right the first time.

While the large acreage underlain by gas shale play leads itself to manufacturing style efficiencies, it is important to establish first the most efficient manufacturing design before putting it into large-scale use.

Early attention to best practices, appropriate to the specific shale play, and emphasis on continuous learning are key.

Rigs, multiwell pads

Fit-for-purpose rigs, with automation and mobility, can reduce the time to drill shale wells. The new generation of gas shale rigs needs:

- Sufficient horsepower (typically 1,000-2,000 hp) to drill long horizontal laterals.
- A compact design for easy mobilization and demobilization, particularly in areas with narrow roads and challenging terrain such as the Marcellus shale.
- Increasingly, a skid-mounting capability.

We have seen instances in which the use of fit-for-purpose rigs, an increasingly experienced crew, and the introduction of performance incentives have cut in half the drilling time of a shale well. Some operators, who have established in-house drilling and other service capabilities, report closer alignment of goals and better control over the quality of operations.

Multiwell pads also can save demobilization-remobilization time and greatly reduce land disturbance. As operators drill gas shale wells on closer spacings, it becomes increasingly efficient to drill multiple wells from a single well pad. This also will reduce land disturbance and access issues in rugged, environmentally sensitive terrain.

Learning-based improvements

Continuous learning, including learning from the successful and less successful experiences of other gas shale operators, can and has led to steadily improving results, such as fewer mechanical well failures, more effective well stimulations, and more optimum well spacing. Some of the better performing gas shale companies have set quantitative expectations, in considerable detail, for learning-based performance improvements.

One example of the benefits of rigorously pursuing learning was gained from the insight that restimulating older hydraulically fraced wells to contact and shatter more of the shale matrix would result in higher well performance. Much of the foundation for pursuing higher gas shale flow rates and enhanced reservoir permeability with intensively stimulated horizontal wells derived from this important insight.

The Denton Creek Trading No. 1 well in the Barnett shale illustrated how an operator converted an initial 1-bcf estimated ultimate recovery well to a 2.9 bcf EUR well with restimulation (Fig. 5). Importantly, this vertical well, as of mid-2009, already has produced 2.2 bcf.

One key aspect of gas shale well performance remains a puzzle, namely the significant variability in well performance, even when the underlying, readily measureable geological reservoir properties appear to be the same or similar.

One example of this is the repeated anomalous presence of side-by-side high and low performing wells. The core area (Wise, Denton, and Tarrant counties) of the Barnett shale provides a larger example of this phenomenon.

This area had more than 1,000 horizontal wells drilled between 2001 and 2006. The best 10% of the wells average about 8 bcf/well while the lowest 30% of the wells average about 1 bcf/well (Fig. 6).

A detailed plot of these wells vs. reservoir properties such as net pay, thermal maturity, and depth provides no clear trends, even for wells drilled and stimulated in a similar manner and at a similar time.

A possible explanation is the complex 3D distribution of small-scale natural fractures and in situ stress, a puzzle that remains tantalizingly below the resolution ability of current seismic and logging tools to unravel.

Entry strategies

Several successful strategies exist for entering a high quality gas shale play, ranging from aggressive leasing of emerging basins to entering into a joint venture with early-mover operators already holding core area acreage.

Gas shale plays with good market access and low transportation tariffs command a premium over gas shale plays and basins with less favorable access to markets. For example, a close-to-market gas shale play such as the Marcellus can have a transportation and market advantage of nearly $2/Mcf compared to a far-from-market Rockies gas shale play.

Sometimes, to counter high transportation cost disadvantages offered by traditional markets, the operator needs to step outside the box. For example, the operators of the northern British Columbia gas shale plays, notably in the Horn River basin, have begun to pursue alternative, higher value markets.

One of these is for shipping the produced gas to nearby Fort McMurray, Alta., to use in production and upgrading of oil sands. The other is for providing the shale gas to the planned LNG export plant at Kitimat, BC, for delivery to higher value Asia-Pacific markets.

In general, the well-prepared early-entry gas shale operator will be able to capture substantial acreage in the core area and gain leases with considerably lower lease bonuses and royalties. This strategy will provide lower breakeven cost opportunities, enabling the company to be one of the low-cost operators, as shown for an early entry operator in the Barnett shale gas play (Fig. 7).

When early-leasing entry is no longer available, the next favorable strategy is to form a joint venture with or acquire one of the early-entry competitors with high resource quality core area acreage.

This is the strategy followed by Shell Canada Ltd. and its acquisition of Duvernay Oil Corp. in the Montney resource play in Canada (OGJ, Sept. 8, 2008, p. 31) and by the BG Group in its joint venture with EXCO Resources Inc. for the Haynesville gas shale play (OGJ, Online, July 2, 2009). ✦

Aramco team plots energy savings at Berri gas plant

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An energy-assessment team for Saudi Aramco has systematically analyzed the interaction between process and utility systems at the company's Berri gas plant and identified realistic and achievable energy-saving opportunities for the plant.

This effort resulted in a number of energy-saving initiatives, which the team prioritized for implementation with a "road-map" strategy.

Long-term plan

As part of a long-term commitment by Saudi Aramco to energy conservation throughout its operating facilities, Saudi Aramco's Berri gas plant embarked on a strategic plan to improve energy efficiency. A complete energy assessment in 2006 yielded specific recommendations.

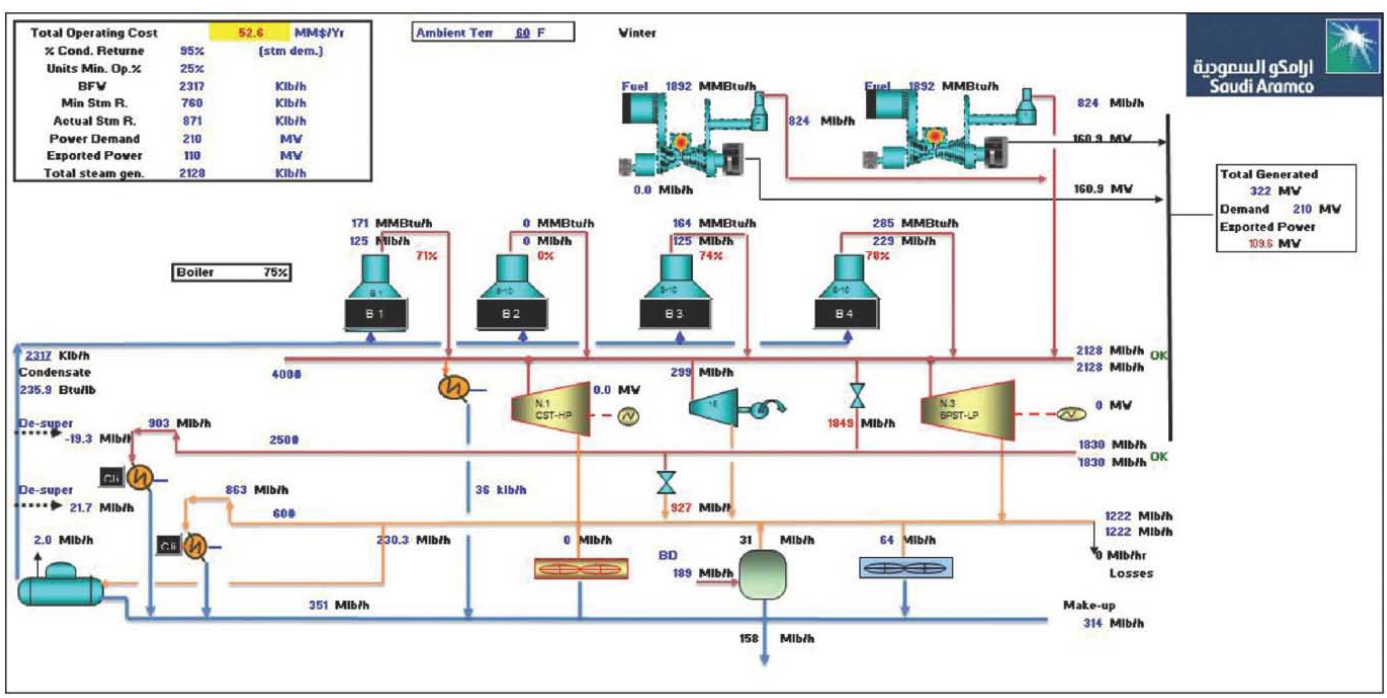
Nonetheless, changes in operating regime and different process and economic scenarios within the subsequent period prompted BGP to reexamine the energy assessment findings that were produced earlier. Hence in April 2008, BGP requested that Saudi Aramco's central energy engineering team, the energy systems unit, reevaluate BGP's energy efficiency performance.

Unlike the earlier studies, BGP had expressed interest in having the team focus only on its NGL-recovery facility, rather than on the entire plant. The NGL-recovery facility contributes significantly to the high energy consumption in the entire plant.

Since BGP involves close interaction between process and utility systems, it is imperative that the plant's utility system be incorporated in this study as a means accurately to quantify energy-saving opportunities from the NGL-recovery plant. The utility system consists of cogeneration, the sulfur plant's steam system, and associated steam system, together with the propane refrigeration system.

By focusing on a specific facility,

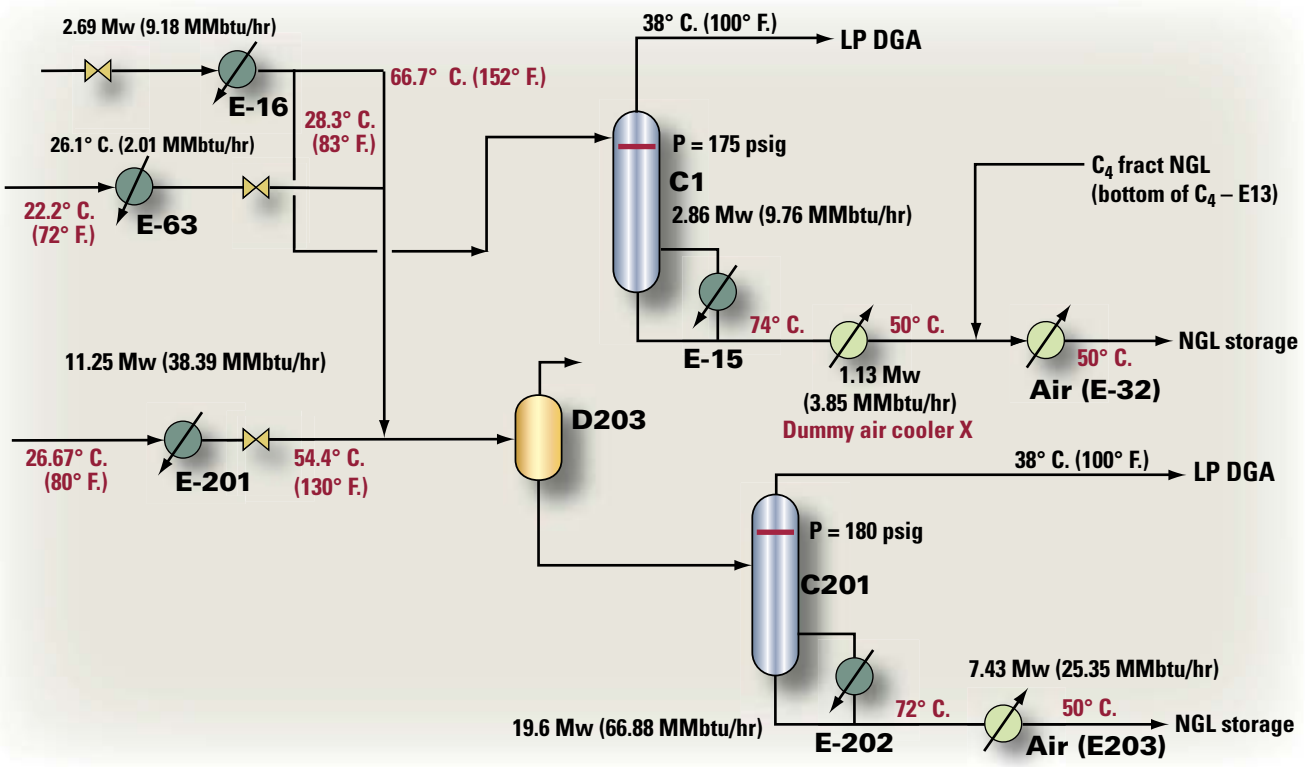
Based on a presentation to the GPA GCC Chapter, 17th Annual Meeting, Abu Dhabi, May 6, 2009.



This is a typical snapshot of the in-house utility system model developed in an Excel based spreadsheet (Fig. 1).

BOTTOMS OF CONDENSATE STRIPPER SENT TO STORAGE

Fig. 2



plant engineers looked forward to seeing recommendations that could be implemented cost effectively.

The assessment or study phase is the most important aspect of any energy saving project. Its objective is simple and clear, i.e., to identify cost-effective energy saving opportunities while considering operability and safety in implementation. Meeting this objective required multidisciplinary technical support. In this case, several process and operation engineers from the Berri plant were involved in the study.

The screening process involved assessing the economic incentive of implementing such an initiative. It is important to note that the criterion used in economic incentive assessment is based on simple payback and the cost estimate used in this work is not rigorous but allows reasonable assessment effectively to identify or screen cost-effective energy saving opportunities. In addition, during screening, each initiative must also consider safety, operability, and constructability.

Process-utility interface

Before the value of energy saving can be estimated, understanding the process-utility interface concept is necessary.[1]

The process system normally consists of the heat exchanger network and separation and-or reactor systems. Nonetheless, the process requires, among other things, heating and cooling to function effectively. Most of the time this requirement is satisfied by the plant's utility system.

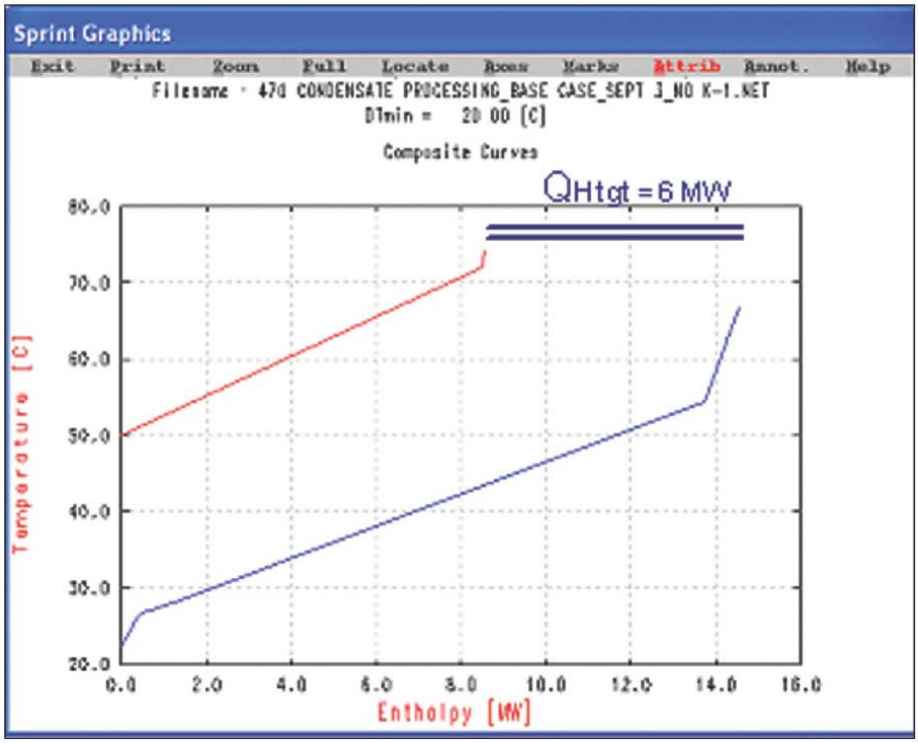
This system typically consists of cogeneration units (gas turbines with waste-heat recovery), boilers, steam turbines, letdown stations, desuperheaters, deaerators, condensate returns, and furnaces and cooling utilities (cooling water system, fin-fan coolers, and refrigeration system).

The utility system's one purpose is to provide the energy interface or link to the process. What is more important is that, because the utility system contributes significantly to the annual energy cost of the facility, this energy cost must be minimized cost effectively. This is in stark contrast to a popular belief that process energy savings can be easily calculated from a "given" utility cost (parameter) rather than from the "marginal" cost.

It is this marginal cost that takes into account the energy link between process and utility systems. Failure to establish this energy interface correctly leads to an inaccurate energy assessment and may pose serious economic implications for the project.[1]

The concept of marginal cost for the utility system is not new. It has been addressed by many in process integration.[2,3] One of the potential reasons that the process utility interface is not given full attention is the failure to recognize the interdependent nature of the utility system itself.

A complex interaction exists in the individual utility hardware itself, let



The composite curve of the condensate stripper areas shows an opportunity to eliminate cold utility requirement from the process (Fig. 3).

alone the interaction of the hardware with the process system. Thus, as in a process system that uses a process simulation tool to assess various interactions within it, we also need a simulation tool for the utility system.

Utility system models

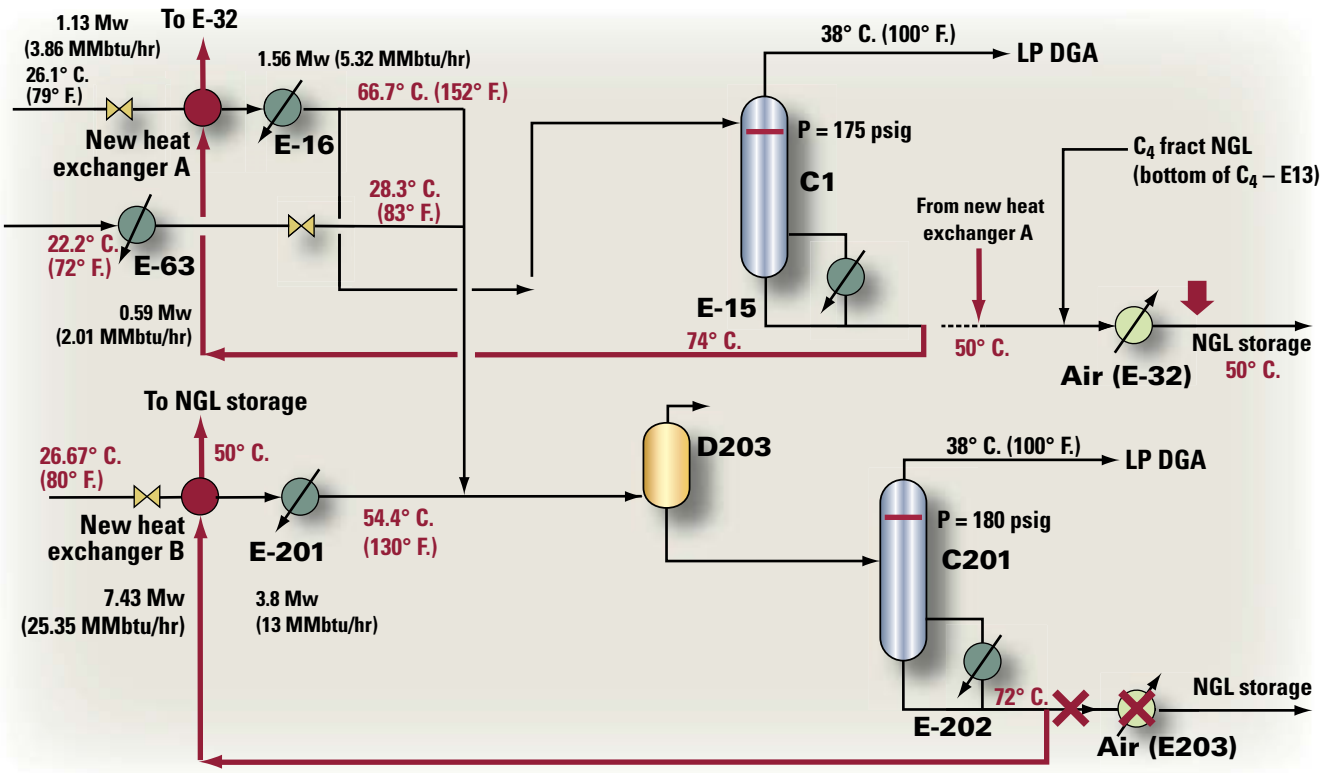
Even though there are several commercial software packages available for the utility system, such as Visual Mesa, AspenUtil, and ProSteam,[4] it was cost effective for Saudi Aramco to develop an in-house model, especially to take advantage of the benefits of the MS Excel-based spreadsheet.

The model performs simultaneous mass, heat, and power balances, as direct access to the steam properties databank is now possible within the spreadsheet. Detailed models of the individual utility equipment, such as steam turbines and boilers, can be easily incorporated.

The models also feature unit constraints, such as minimum and

ELIMINATE USE OF AIR COOLER E203

Fig. 4



maximum capacities of the equipment, and fixed heating and power demand, which are critical for realistic modeling.[1] More importantly, the availability of an optimization solver within the Excel-based spreadsheet allows the utility system optimization to be performed. Fig. 1 shows the typical configuration of the utility system.

Approach

In a typical energy assessment, we first focus on the process area to find energy-saving opportunities. This involves using a process simulation tool in conjunction with pinch analysis software.[2]

The amount of energy savings in each of the identified opportunities is then determined based on its energy value rather than on the cost. Typically, the units of the energy value are, among others, MMbtu/hr, Mw, and ton or pound of steam. At the same time, these opportunities are deliberated for any operability concerns, should these opportunities be implemented.

A separate assessment develops a utility model to reflect the existing performance of the utility system of the plant. Once this model is optimized to reflect the existing operating conditions of the utility system, the model can quantify the actual value of energy saving opportunities from the process.[1]

Based on the quantity of the energy savings determined from the process area, we then used this figure in our utility model as the amount of reduction in utility, i.e., the amount of utility generated from the utility system. In our case, the amount of steam reduction from the process, as a result of energy efficiency improvement, should be reflected in the utility model by modifying the steam balance of the system.

There are two serious negative implications if we implement the energy saving initiative immediately without using the utility model to account for this imbalance.[1]

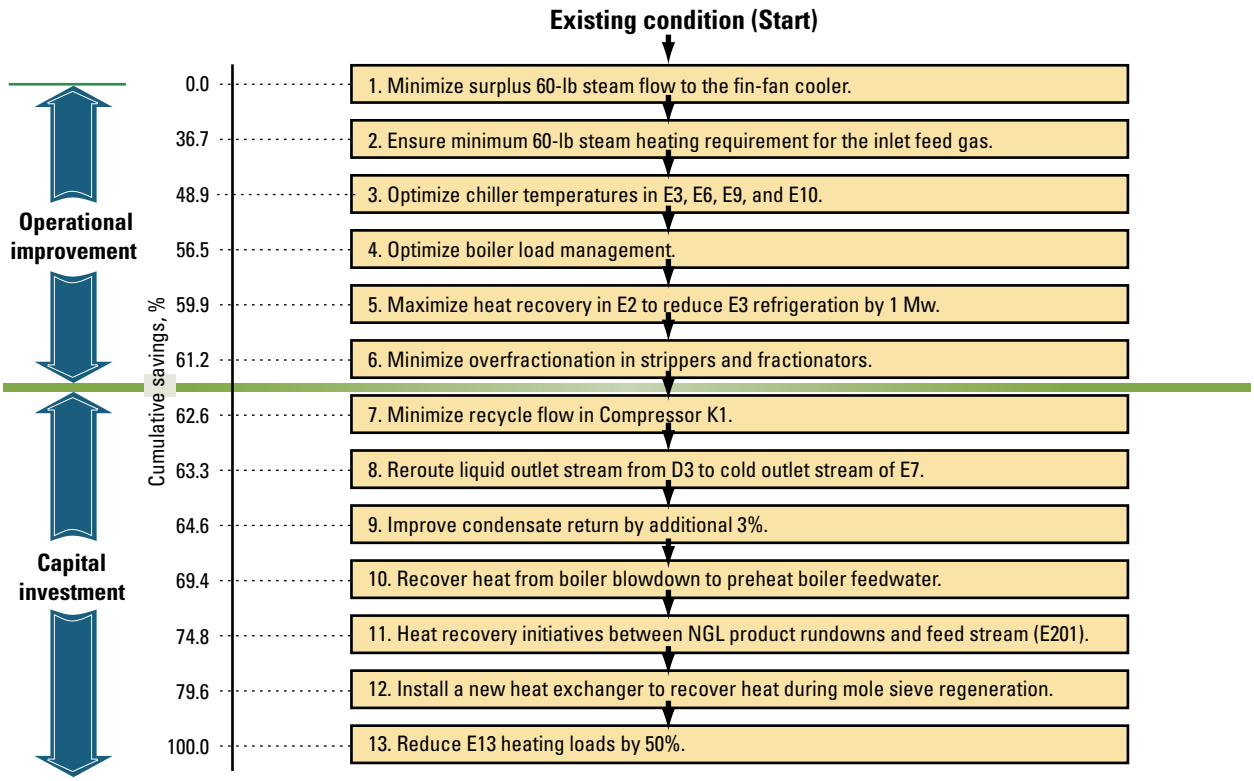
First, we may end up of having this saved or "unused" steam to be vented off unnecessarily, making the actual value of the energy saving zero. Or we simply lose the opportunity to take advantage of the excess steam to generate more power from our steam turbines, provided that we have additional capacity to do so. This in essence reduces our demand for external power requirements, and hence an actual value of energy saving could have been realized.

Secondly, one may reduce the fuel consumption in the boiler to reflect the reduction in steam demand. Even though intuitively this is the logical thing to do, in many cases, this approach reduces the steam turbines' capacities to sustain their power generation. The worst part is that we have to resort to external power, which is relatively costly, to make up the loss of power generation from these turbines. This obviously defeats the purpose of the energy-saving initiative.

Hence, the clear advantage of having

ROADMAP TO ENERGY-SAVING GOALS

Fig. 5



this utility model is that it allows us to maximize the actual value of energy saving in monetary form. The approach we adopted here was somewhat similar to the one used to determine the marginal utility cost.[3-5] We instead use the utility model to link to the potential energy savings from the process, as we determined earlier in terms of either MMbtu/hr or ton of steam.

Since the savings from the process reflect the utility imbalance throughout the utility system, the utility model is then used to correct the imbalance, by optimizing the system, taking into account all physical and capacity constraints of the utility system.

Application

Here's a specific example of how the concept is applied to determine the actual value of energy savings in a condensate stripper system of Berri's NGL-recovery plant.

Fig. 2 shows the processing area covering the condensate strippers (C1 and C201) and the associated heat exchangers surrounding these strippers. The liquid feeds, which are predominantly hydrocarbon liquids recovered from the slug catchers, have to be stripped to remove any light hydrocarbons until the liquid outlet streams achieve specifications as NGL products (stabilized NGL).

Currently, the existing heat exchangers, involving feed preheating and product rundown cooling, use steam and air cooling, respectively. As such, a potential heat recovery between feed preheating and product rundown could provide an opportunity to reduce energy consumption in this area.

Pinch analysis identified the scope for heat recovery for the entire condensate stripper area. Fig. 3 shows a relevant composite curve from pinch analysis software[6] that demonstrates that the condensate stripper area requires only a minimum hot utility of 6 Mw and no cold utility.

To achieve the target of 6 Mw, two possible heat-recovery opportunities can be identified from C1 and C201, respectively. Fig. 4 shows the schematic of these two opportunities that highlights the heat recovery between the NGL product rundown and the preheating within C1 and C201, respectively. Furthermore, the illustration highlights new pipe work and heat exchanger requirements.

Based on the proposed opportunities, the 60-lb steam savings are estimated to be 4,000 lb/hr and 28,000 lb/hr for E16 and E201, respectively. The savings, quoted in terms of pounds of steam use, are then to be quantified in monetary terms using the rigorous in-house utility modeling tools.

These energy savings were determined to be worth $830,000/year in E201 unit and $133,000/year in E16 unit. Eliminating air cooler E203 led to electricity savings valued around $30,000/year. Thus the total energy saving at C201 area alone is around $860,000/year.

While this task is being performed, the team deliberated the pros and cons of the proposed opportunities. The operation engineer stressed that stripper C1 is not normally used, as the incoming feeds to C1 are normally in a batch form.

In a year, the frequency of using C1 stripper is rather small, and based on this argument the team decided to focus on the stripper C201 area instead, where exchanger E201 consumes significant amounts of steam. In addition, the team briefly assessed the pipe work requirement from the site layout perspective, together with the potential hydraulic requirement.

The cost estimate for the new heat exchanger NEWHXB (for stripper C201 area; Fig. 4) was determined. The cost did not include the piping cost, as the heat exchanger cost is used here to screen the energy saving initiative. If the initiative is selected for detail design assessment, the piping cost, together with any hydraulic requirement, will obviously be included.

Implementation guidelines

The study identified 21 energy saving opportunities, of which 13 met the technical and economic criteria. Two classes of energy saving implementation plan were developed, operational improvement, involving practically zero investment, and capital cost initiatives.

These initiatives are prioritized according to a strategic energy saving "road map" (Fig. 5) to assist the Berri plant in implementing the recommended initiatives. Logically, the low risk and no cost projects should be carried out first, followed by the capital cost project.

About 60% of the total energy savings is attributed to operational improvement alone. This should provide an incentive for the Berri plant to focus immediately on operational improvement to achieve an immediate impact on the plant's energy saving initiatives. As demonstrated in this study, the Berri plant's utility system offers huge opportunities for energy conservation, especially through minimizing venting steam (Initiative 1).

As for the capital investment opportunities, the overall project was estimated to give a simple payback of less than a year. Since this showed promising economics, the team recommended that preliminary detail engineering work be initiated at the same time that the plant focuses its attention on operational improvement initiatives.

Status

The Berri gas plant is currently pursuing the initiatives with formation of an in-house energy-saving task force whose purpose is to coordinate the implementation plan within the

plant. The task force team has given the operational improvement initiatives the highest priority for implementation. As such, detail discussion with the central engineering team is under way to implement some of the operational improvement initiatives. ✦

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NELSON-FARRAR COST INDEXES

Refinery construction (1946 basis)
(Explained in OGJ, Dec. 30, 1985, p. 145)

	1962	1980	2006	2007	2008	June 2008	May 2009	June 2009
Pumps, compressors, etc.	222.5	777.3	1,758.2	1,844.4	1,949.8	1,938.2	2,013.8	2,014.7
Electrical machinery	189.5	394.7	520.2	517.3	515.6	515.9	514.6	513.7
Internal-comb. engines	183.4	512.6	959.7	974.6	990.9	984.6	1,018.7	1,019.3
Instruments	214.8	587.3	1,166.0	1,267.9	1,342.1	1,341.5	1,392.5	1,392.7
Heat exchangers	183.6	618.7	1,162.7	1,342.2	1,354.6	1,374.7	1,253.8	1,253.8
Misc. equip. average	198.8	578.1	1,113.3	1,189.3	1,230.6	1,231.0	1,238.7	1,238.8
Materials component	205.9	629.2	1,273.5	1,364.8	1,572.0	1,727.6	1,266.1	1,268.0
Labor component	258.8	951.9	2,497.8	2,601.4	2,704.3	2,674.3	2,799.2	2,813.2
Refinery (Inflation) Index	237.6	822.8	2,008.1	2,106.7	2,251.4	2,295.6	2,185.9	2,195.2

Refinery operating (1956 basis)
(Explained in OGJ, Dec. 30, 1985, p. 145)

	1962	1980	2006	2007	2008	June 2008	May 2009	June 2009
Fuel cost	100.9	810.5	1,569.0	1,530.7	1,951.3	2,587.4	839.0	904.5
Labor cost	93.9	200.5	204.2	215.8	237.9	228.6	254.0	258.7
Wages	123.9	439.9	1,015.4	1,042.8	1,092.2	1,104.2	1,131.6	1,178.9
Productivity	131.8	226.3	497.5	483.4	460.8	483.0	445.6	455.7
Invest., maint., etc.	121.7	324.8	743.7	777.4	830.8	847.1	800.7	804.1
Chemical costs	96.7	229.2	365.4	385.9	472.5	489.3	386.9	401.0
Operating indexes								
Refinery	103.7	312.7	579.0	596.5	674.1	736.5	559.2	569.6
Process units*	103.6	457.5	870.7	872.6	1,045.1	1,270.6	650.1	675.6

*Add separate index(es) for chemicals, if any are used. See current Quarterly Costimating, first issue, months of January, April, July, and October.

These indexes are published in the first issue of each month. They are compiled by Gary Farrar, OGJ Contributing Editor.

Indexes of selected individual items of equipment and materials are also published on the Costimating page in the first issue of the months of January, April, July, and October.

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Changes in the indexes for nonmetallic building materials

Gary Farrar
Contributing Editor

The table at the top of this page shows how Nelson-Farrar indexes have changed during 2006-08 for selected basically nonmetallic building materials.

Data are included for the overall nonmetallic group, five nonmetallic materials, and iron castings.

Fireclay brick and iron castings indexes showed the greatest changes.

Fireclay brick, showing the greater gains of the two, changed to 1,805.6 in fourth quarter 2008 from 1,516.2 in first quarter 2006. Iron castings changed to 1,607.7 in fourth quarter of the period tested from 1,332.7 in the first quarter.

Concrete ingredients and concrete products showed more moderate changes, although none of the changes in the indexes was drastic. The concrete ingredients index rose to 1,242.2 during the 3-year period from 1,061.0. During the same period concrete products changed to 1,015.7 from 891.7.

The two smallest index changes occurred in the clay products and building brick categories. Clay products changed to 981.9 in fourth quarter 2008 from 937.1 in first quarter 2006. Building brick changed to 1,434.0 during the time period from 1,376.9.

The final category, the overall nonmetallic index, changed to a high of 1,110.0 during fourth quarter 2008 from 941.2. ✦

INDEXES FOR SELECTED CONSTRUCTION MATERIALS

Year, quarter	Non-metallic	Building brick	Fireclay brick	Iron castings	Clay products	Concrete ingred.	Concrete products
2006							
1	941.2	1,376.9	1,516.2	1,332.7	937.1	1,061.0	891.7
2	967.6	1,409.1	1,544.9	1,344.3	950.1	1,084.9	921.0
3	984.8	1,415.0	1,547.4	1,357.5	956.0	1,106.3	934.7
4	984.8	1,433.3	1,553.3	1,370.8	963.1	1,115.9	937.1
Year	**969.6**	**1,408.6**	**1,540.5**	**1,351.3**	**951.6**	**1,092.0**	**921.1**
2007							
1	999.4	1,434.0	1,603.9	1,377.4	957.7	1,150.0	953.2
2	1,004.3	1,428.9	1,608.2	1,427.9	964.1	1,174.0	961.7
3	1,005.9	1,431.8	1,619.1	1,427.1	969.5	1,178.8	963.6
4	1,003.2	1,421.6	1,633.5	1,424.6	961.4	1,186.2	967.9
Year	**1,003.2**	**1,429.1**	**1,616.2**	**1,414.3**	**963.2**	**1,172.2**	**961.6**
2008							
1	1,018.3	1,420.9	1,679.0	1,466.9	970.1	1,219.8	978.8
2	1,037.7	1,425.3	1,738.9	1,554.6	966.3	1,226.8	993.9
3	1,095.4	1,430.4	1,748.2	1,677.2	973.3	1,236.4	1,000.6
4	1,110.0	1,434.0	1,805.6	1,607.7	981.9	1,242.2	1,015.7
Year	**1,065.3**	**1,427.6**	**1,742.9**	**1,576.6**	**972.9**	**1,231.3**	**997.3**

ITEMIZED REFINING COST INDEXES

The cost indexes may be used to convert prices at any date to prices at other dates by ratios to the cost indexes of the same date. Item indexes are published each quarter (first week issue of January, April, July, and October). In addition the Nelson Construction and Operating Cost Indexes are published in the first issue of each month of Oil & Gas Journal.

Operating cost (based on 1956 = 100.0):	1954	1972	2006	2007	2008	May 2009	*References	Index for earlier year in Costimating and Questions on Technology issues
Power, industrial electrical	98.5	131.2	850.2	897.3	939.2	926.2	Code 0543	No. 13, May 19, 1958, p. 181
Fuel, refinery price	85.5	152.0	1,523.6	1,497.0	1,821,7	798.4	OGJ	No. 4, Mar. 17, 1958, p. 190
Gulf cargoes	85.0	130.4	2,023.9	1,968.0	2,755.5	1,201.1	OGJ	No. 4, Mar. 17, 1958, p. 190
NY barges	82.6	169.6	1,837.5	2,066.9	2,829.7	1,877.8	OGJ	No. 4, Mar. 17, 1958, p. 190
Chicago low sulfur	—	—	1,765.8	2,046.7	2,754.0	1,907.6	OGJ	July 7, 1975, p. 72
Western US	84.3	168.1	2,358.1	2,704.2	3,642.4	2,442.2	OGJ	No. 4, Mar. 17, 1958, p. 190
Central US	60.2	128.1	1,765.9	1,886.9	2,615.7	1,266.2	OGJ	No. 4, Mar. 17, 1958, p. 190
Natural gas at wellhead	83.5	190.3	6,306.5	6,118.7	7,260.5	2,902.5	Code 531-10-1	No. 4, Mar. 17, 1958, p. 190
Inorganic chemicals	96.0	123.1	686.8	743.6	1,044.9	1,141.5	Code 613	Oct. 5, 1964, p. 149
Acid, hydrofluoric	95.5	144.4	414.9	414.9	414.9	414.9	Code 613-0222	Apr. 1, 1963, p. 119
Acid, sulfuric	100.0	140.7	397.4	397.4	397.4	439.1	Code 613-0281	No. 94, May 15, 1961, p. 138
Platinum	92.9	121.1	1,344.5	1,557.8	1,524.5	900.9	Code 1022-02-73	July 5, 1965, p. 117
Sodium carbonate	90.9	119.4	452.4	490.1	688.5	753.7	Code 613-01-03	No. 58, Oct. 12, 1959, p. 186
Sodium hydroxide	95.5	136.2	620.1	671.6	943.4	1,032.8	Code 613-01-04	No. 94, May 15, 1961, p. 138
Sodium phosphate	97.4	107.0	733.7	733.7	733.7	733.7	Code 613-0267	No. 58, Oct. 12, 1959, p. 186
Organic chemicals	100.0	87.4	764.5	799.9	958.1	688.7	Code 614	Oct. 5, 1964, p. 149
Furfural	94.5	137.5	1,103.1	1,174.1	1,382.7	993.8	Chemical Marketing Reporter	No. 58, Oct. 12, 1959, p. 186
MEK, tank-car lots	82.6	87.5	625.0	625.0	625.0	625.0	Reporter	
Phenol	90.4	47.1	374.9	413.0	479.4	500.3	Code 614-0241	No. 58, Oct. 12, 1959, p. 186

ITEMIZED REFINING COST INDEXES

Operating cost (based on 1956 = 100.0):	1954	1972	2006	2007	2008	May 2009	*References	Index for earlier year in Costimating and Questions on Technology issues
Operating labor cost (1956 = 100)								
Wages & benefits	88.7	210.0	1,015.4	1,042.8	1,092.2	1,131.6	Employ & Earn	No. 41, Feb. 16, 1969
Productivity	97.2	197.0	497.5	483.4	460.8	445.6	Employ & Earn	No. 41, Feb. 16, 1969
Construction labor cost (1946 = 100)								
Skilled const.	174.6	499.9	2,240.7	2,344.4	2,434.3	2,513.3	Eng. News Record	No. 55, Nov. 3, 1949
Common labor	192.1	630.6	2,971.7	3,083.0	3,200.4	3,330.1	Eng. News Record	No. 55, Nov. 3, 1949
Refinery cost	183.3	545.9	2,497.8	2,601.4	2,704.3	2,799.2	OGJ	May 15, 1967, p. 97
Equipment or materials (1946 = 100):								
Bubble tray	161.4	324.4	1,484.0	1,561.4	1,737.8	1,518.6	Computed	July 8, 1962, p. 113
Building materials (nonmetallic)	143.6	212.4	969.6	1,003.2	1,065.3	1,092.7	Code 13	No. 61, Dec. 15, 1949
Brick—building	144.7	252.5	1,408.6	1,429.1	1,427.6	1,418.7	Code 1342	No. 20, Mar. 3, 1949
Brick—fireclay	193.1	322.8	1,540.5	1,616.2	1,742.9	1,897.6	Code 135	May 30, 1955, p. 104
Castings, iron	188.1	274.9	1,351.3	1,414.3	1,576.6	1,476.8	Code 1015	Apr. 1, 1963, p. 119
Clay products (structural, etc.)	159.1	342.0	951.6	963.2	972.9	969.0	Code 134	No. 20, Mar. 3, 1949
Concrete ingredients	141.1	218.4	1,092.0	1,172.2	1,231.3	1,266.7	Code 132	No. 22, Mar. 17, 1949
Concrete products	138.5	199.6	921.1	961.6	997.3	1,015.2	Code 133	Oct. 2, 1967, p. 112
Electrical machinery	159.9	216.3	520.2	517.3	515.6	514.6	Code 117	May 2, 1955, p. 104
Motors and generators	157.7	211.0	880.3	917.1	964.2	994.5	Code 1173	May 2, 1955, p. 104
Switchgear	171.2	271.0	1,147.3	1,212.2	1,254.4	1,279.0	Code 1175	May 2, 1955, p. 104
Transformers	161.9	149.3	612.5	696.9	766.4	731.1	Code 1174	No. 31, May 19, 1949
Engines (combustion)	150.5	233.3	959.7	974.6	990.9	1,018.7	Code 1194	No. 36, June 23, 1949
Exchangers (composite)	171.7	274.3	1,162.7	1,342.2	1,354.6	1,253.8	Manufacturer	Mar. 16, 1964, p. 154
Copper base	190.7	266.7	1,059.4	1,201.8	1,221.6	1,161.0	Manufacturer	Mar. 16, 1964, p. 154
Carbon steel	156.8	281.9	1,162.1	1,344.7	1,369.2	1,287.3	Manufacturer	Mar. 16, 1964, p. 154
Stainless steel (304)	—	—	1,174.8	1,322.1	1,319.5	1,183.0	Manufacturer	July 1, 1991, p. 58
Fractionating towers	151.0	278.5	1,207.2	1,274.3	1,379.5	1,327.8	Computed	June 8, 1963, p. 133
Hand tools	173.8	346.5	1,792.5	1,830.6	1,918.2	1,992.8	Code 1042	June 27, 1955
Instruments (composite)	154.6	328.4	1,166.0	1,267.9	1,342.1	1,392.5	Computed	No. 34, June 9, 1949
Insulation (composite)	198.5	272.4	2,257.4	2,258.6	2,213.1	2,201.9	Manufacturer	July 4, 1988, p. 193
Lumber (composite):	197.8	353.4	1,309.8	1,204.1	1,134.5	995.2	Code 81	No. 7, Dec. 2, 1948
Southern pine	181.2	303.9	984.3	846.4	780.3	668.3	Code 81102	No. 7, Dec. 2, 1948
Redwood, all heart	238.0	310.6	1,948.1	1,744.3	1,607.9	1,377.4	Code 811-0332	July 5, 1965, p. 117
Machinery								
General purpose	159.9	278.5	1,213.7	1,271.8	1,338.9	1,379.7	Code 114	Feb. 17, 1949
Construction	165.9	324.4	1,559.7	1,594.4	1,645.6	1,696.2	Code 112	Apr. 1, 1968, p. 184
Oil field	161.9	269.1	1,599.1	1,715.8	1,858.8	1,910.9	Code 1191	Oct. 10, 1955, p. 267
Paints—prepared	159.0	231.8	1,040.8	1,078.5	1,150.1	1,224.8	Code 621	May 16, 1955, p. 213
Pipe								
Gray iron pressure	195.0	346.9	2,687.9	2,730.8	2,865.0	2,873.4	Code 1015-0239	Jan. 3, 1983, p. 76
Standard carbon	182.7	319.9	2,306.9	2,299.2	2,904.9	2,399.0	Code 1017-0611	Jan. 3, 1983, p. 76
Pumps, compressors, etc.	166.5	337.5	1,758.2	1,758.4	1,949.8	2,013.8	Code 1141	No. 29, May 5, 1949
Steel-mill products	187.1	330.6	1,527.5	1,620.0	1,973.5	1,348.4	Code 1017	Jan. 3, 1983, p. 73
Alloy bars	198.7	349.4	1,311.8	1,239.7	1,469.8	1,063.0	Code 1017-0831	Apr. 1, 1963, p. 119
Cold-rolled sheets	187.0	365.5	1,658.4	1,916.6	1,935.6	1,304.7	Code 1017-0711	Jan. 3, 1983, p. 73
Alloy sheets	177.0	225.9	862.4	996.7	1,006.6	678.5	Code 1017-0733	Jan. 3, 1983, p. 73
Stainless strip	169.0	221.2	920.7	1,064.2	1,074.7	724.2	Code 1017-0755	Jan. 3, 1983, p. 73
Structural carbon, plates	193.4	386.7	1,766.6	1,945.3	2,383.6	1,636.9	Code 1017-0400	Jan. 3, 1983, p. 73
Welded carbon tubing	180.0	265.5	2,337.3	2,329.6	2,943.2	2,431.3	Code 1017-0622	Jan. 3, 1983, p. 73
Tanks and pressure vessels	147.3	246.4	1,014.3	1,076.4	1,160.7	1,160.2	Code 1072	No. 5, Nov. 18, 1949
Tube stills	123.0	125.3	579.9	612.0	714.1	553.7	Computed	Oct. 1, 1962, p. 85
Valves and fittings	197.0	350.9	1,839.6	1,943.9	2,048.8	2,132.7	Code 1149	No. 46, Sept. 1, 1940
Nelson-Farrar Refinery (Inflation Index)								
(1946)	179.8	438.5	2,008.1	2,106.7	2,251.4	2,185.9	OGJ	May 15, 1969
Nelson-Farrar Refinery Operation								
(1956)	88.7	118.5	579.0	596.5	674.2	559.2	OGJ	No. 2, Mar. 3, 1958, p. 167
Nelson-Farrar Refinery Process								
(1956)	88.4	147.0	870.7	872.6	1,045.1	650.1	OGJ	No. 2, Mar. 3, 1958, p. 167

*Code refers to the index number of the Bureau of Statistics, US Department of Labor, "Wholesale Prices" Itemized Cost Indexes, Oil & Gas Journal.

CYBER SECURITY—Conclusion

SCADA system protection requires independent barriers

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A risk assessment, combined with a vulnerability assessment and threat scenario analysis, specifically identifies cyber vulnerabilities that may require elimination from a pipeline system. Elimination of vulnerabilities isn't always possible, however, especially with little control over the operating system and networking software used as the basis of supervisory control and data acquisition systems.

Relying on the various vendors to identify vulnerabilities and supply patches eliminating them is a never-ending process. The only solution is to place independent barriers and protections (technical countermeasures) around a SCADA system to try to keep its communication paths secure.

The first article in this series (OGJ, Sept. 28, 2009, p. 62) described a risk assessment for cyber attack before detailing a number of potential attack avenues. This concluding part will detail the application of a particular approach to vulnerability assessment.[1]

DNSAM

One often referenced commercial assessment methodology is DuPont Corp.'s proprietary DNSAM methodology (DuPont Network Security Assessment Methodology), deployed successfully in almost all of the company's industrial facilities worldwide. The methodology is designed to be simple and to operate independently of any particular type of automation system.

DNSAM's basic concept works on the justified assumption that a cyber attack requires a communications path between an attacker and the critical cyber assets, and only a few types of communication paths really merit worry. DNSAM breaks the critical systems into LAN segments before identifying the connections between various segments, the cyber assets present on each segment, and the communication interfaces into each of those segments. DNSAM then presumes the worst-case scenario (total loss) for all of the assets on each local segment and determines the consequences.

If a local segment has a dangerous communications interface (dial-in telephone, wireless, or Internet), DNSAM assumes an attack against the assets on that segment is highly likely. If a local segment is isolated (no interconnections or only via a protective firewall), DNSAM classifies an attack against assets on that segment as unlikely.

In between those extremes lie segments with external WAN connectivity (attacks being likely) and connectivity with internal LAN/WAN networks (attacks being somewhat likely).

Evaluating interfaces into a given network segment requires remembering the possibility of alternate communication interfaces. Fig. 1 provides a representative example of determining network segmentation. Segments end at a filtering device (a firewall or other device with user-definable access control list rules). A simple Layer 2 switch doesn't terminate a segment.

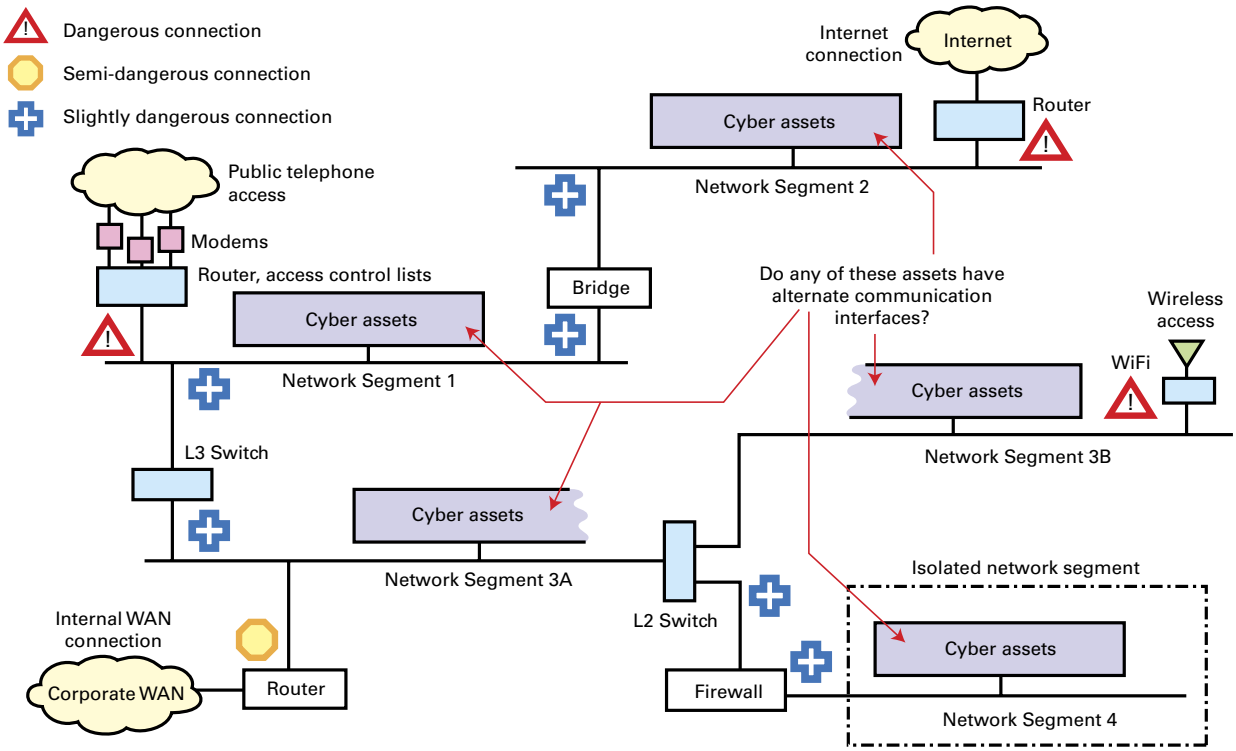
Network Segment 1 has three communication connections in Fig. 1: one for dial-in telephone access via a router, the other two internal network connections. Network Segment 2 has two communication connections: an internet connection and an internal network connection.

Network Segment 3 has two parts (connected through a Layer 2 switch) and four communication connections: two internal network connections, a connection to an internal WAN, and a wireless Ethernet (WiFi) access point. Network Segment 4 has only one communication connection: an internal network connection.

A pure DNSAM approach would rank the cyber assets on network Segments 1 and 2 as highly likely to be attacked, the cyber assets on network Segment 3 as only likely to be attacked, and those on network Segment 4 as

DNSAM ASSESSMENT METHODOLOGY SYSTEM CONFIGURATION

Fig. 1



unlikely to be attacked.

DNSAM assumes physical and operational security is being addressed separately and doesn't specifically address the evil-insider threat agent. It therefore doesn't consider the manual delivery of malware, which is either forbidden by policies (operational security) or blocked by disabling those drives, ports, and interfaces as part of baseline configuration-setting procedures (operational security).

DNSAM also ignores non TCP/IP communication interfaces, such as serial communication channels used for RTU polling. DNSAM, finally, considers only firewalls as a suitable countermeasure. Its focus on communication interfaces creates this approach, but other countermeasures could also be employed.

Variation

A variation of the DNSAM approach is probably an acceptable methodology for conducting a pipeline SCADA system risk assessment. Considering only IP-based communication interfaces fails to address the situation adequately, nor can operational security be ignored as a necessary component of overall cyber security. Addressing intolerable vulnerabilities—those enabling an attack resulting in unacceptable consequences—also requires examining the full spectrum of available countermeasures.

Hacker conferences have hosted numerous papers and presentations on industrial automation systems and the communication protocols used in them. An attacker could attack field sites by accessing the serial communications to those sites and simulating control command messages. Several suppliers offer protocol test sets simulating almost any SCADA/RTU protocol and generating a full range of RTU commands.

A pure DNSAM assessment approach usually ignores communication channels not supporting routable protocols (such as the TCP/IP suite), allowing intermediate computers to receive messages addressed to other computers and attempt to pass them along to the actual addressee.

Typical SCADA serial protocols for RTU polling and supervisory control are not routing protocols, and there is no way for an attacker to hack into a computer and access the operating system, plant malware, and alter software by sending messages back along a polling channel.

RTU serial protocols have a fixed set of predefined commands and message types and well-defined responses to each. Any variation from that well-defined structure will cause a message or response to be rejected.

But it would be possible for an attacker to send false data back to the SCADA system by sending forged poll-response messages, causing the SCADA system see what the attacker wants it to see (open valves looking closed, running pumps appearing to be stopped, pressure and flow measurements apparently stable, etc.).

An attacker with access to RTU polling channels can also send supervisory

CYBER-ASSET ATTACK SCENARIOS

Table 1

Asset	Goal	Method	Consequences	Path
Primary SCADA server	Disable server	Infect server with virus, worm	Backup SCADA server automatically takes over without disruption (minimal)	Manual transport, network (IP) connection
Primary, backup SCADA servers	Disable server	Infect server with virus, worm	SCADA system needs reloading from backup, reboot. Supervisory control lost 1-2 hr (low)	Manual transport, network (IP) connection
Operations consoles	Disable consoles	Infect server with virus, worm	If all consoles infected, all need reloading from backup, reboot. Supervisory control lost 1-2 hr (low)	Manual transport, network (IP) connection
Operations consoles	Remote control	Install a root kit in console(s)	Attacker can issue control commands, shutting down or damaging pipeline (moderate-severe)	Manual transport, network (IP) connection
SCADA application server	Disable	Infect server with virus, worm	Advanced control, models, optimization, scheduling lost up to 48 hr (low-moderate)	Manual transport, network (IP) connection
SCADA application server	Use to issue supervisory controls	Infect with specifically tailored application	Ability to issue control commands potentially shutting or damaging pipeline	Manual transport, network (IP) connection
SCADA historian server	Disable, lose all data	Infect server with virus, worm	Trending lost up to 8 hr while reloading from backup (minimal)	Manual transport, network (IP) connection
Booster station control systems	Remote control	Install root kit in console(s), or attack RTU polling circuit	Cause overpressure and release, damage station (moderate-severe)	Manual transport, network (IP) connection, stolen protocol test set
SCADA application server	Delete inventory, accounting databases	Infect server with tailored virus or worm, attacking RdB files	Reconstruction of inventory information from backup and local tickets (low)	Manual transport, network (IP) connection

control messages out to the RTUs and cause them to start-stop and open-close field devices or issue any other supported supervisory command (such as changing set points, alarm limits, tuning constants, etc.). The degree of possible damage this could generate depends on the intelligence level of the RTU (how much local, semi-autonomous regulatory control and sequence-safety logic it performs), the types of equipment it directly operates (valves, pumps, motors, etc.), and the presence (or lack) of hard-wired safety logic capable of overriding the RTU's controls.

Installation and commissioning of a SCADA system or a new RTU often uses protocol test sets when one or the other is unavailable and something is needed to simulate the missing component, making it quite within the capabilities of a commercially available test set to simulate field conditions or act in the role of the SCADA system.

Vulnerability assessment

One typical approach used in a vulnerability assessment examines various scenarios in which an asset could be attacked, identifies the real consequences of a successful attack, and then reviews the difficulty involved in staging such an attack. A table of scenarios can document this process (Table 1).

It is important to state accurately the consequences of having a cyber asset compromised, altered, deleted, or disabled. A cyber attack can disable computers and overload communication networks. A cyber attack can delete or alter data or insert malware, providing an attacker with remote access to critical systems. But completely reformatting hard drives and reloading the affected computers (and other infected network components) from "clean" backup media, usually puts things back as they were before the attack.

This takes time (once it is actually realized an attack is in progress) and requires thoroughly tested, well-documented, and well-rehearsed procedures for performing a system restoration. SCADA systems used for supervising critical processes (such as pipeline transportation) almost always have full (or as near as is possible) redundancy. For very critical pipelines there might even be a backup operating site with another complete SCADA system sitting ready.

An assessment of attack consequences must remember these factors, although a serious attacker would probably be aware of them and take them into account. In an assessment of attack-scenario success likelihood, the more things needing happen in parallel or sequence for success, the lower the likelihood. If an attack-scenario, therefore, only results in dire consequences if the attacker can take out the primary and redundant backup SCADA system at both the main and alternate operating sites, the success likelihood is low.

Redundancy usually requires sharing a common LAN and updating communication processes between the redundant equipment and the primary and backup sites. Failure to protect these communication links adequately offers a path for an attacker to get to the full

range of system components. Redundancy alone will not protect against a cyber attack.

Rating the likelihood of each of the attack scenarios is usually a qualitative process. Probability of an attack is highly likely, likely (probable), somewhat likely (possible), or unlikely, strictly based on the available communications interfaces giving an attacker access to your cyber assets (remembering DNSAM omits manual delivery of malware and non-routing communication interfaces).

Effects of a cyber attack on a pipeline SCADA system may include:

- Loss of critical data, programs.
- Alteration of critical data.
- Partial loss of operational visibility.
- Full loss of operational visibility.
- Partial loss of supervisory control.
- Full loss of supervisory control.
- Partial usurpation of supervisory control.
- Full usurpation of supervisory control.

More important, however, is the effect of these events on the pipeline and associated facilities. Altering or deleting critical applications or data could degrade the operational capabilities of a SCADA system, resulting in a loss of scheduling, batch tracking ability, pressure models, leak detection, etc.

Such an attack would imply thorough knowledge of the inner workings of the SCADA system. Brute force deletion of all system files and programs, on the other hand, would require little knowledge and could shut down the SCADA system.

Disabling selected functions, such as alarm management or RTU polling, could blind the operators to a dangerous situation for a moderate period of time. Totally depriving operators of communications with the field equipment or an attacker issuing supervisory commands to field devices represents the worse-case scenario. An attacker might be able to open or close valves, start or stop pumps-compressors, or change operational set points and actually cause physical damage to a pipeline, resulting in a release, pressure drop, product loss, environmental, contamination, explosions, fire, death, injury, or other serious consequences.

The temporary shutdown of a pipeline is conceivable. But if an attack is purely a cyber one against the pipeline's SCADA system, it will be possible eventually to restore the system to proper operation. Operators must consider how long the restoration process will take and how bad things can get along the pipeline, and associated facilities, in the meantime.

Attack

A cyber attack on a pipeline's SCADA system is probably not intended to harm the SCADA system but rather use the SCADA system to trigger actions harmful to the pipeline and associated facilities. Taking control of field equipment, moreover, can be done without breaking into and usurping control of a SCADA system, by instead getting access to the communications circuits linking the SCADA system to the field-based RTUs and control systems.

Unencrypted radio, analog telephone, and TCP/IP communication channels are attack points capable of being used to take control of field devices or remote automation systems. Customary engineering practice builds a reasonable number of safeguards into pipeline design and automation. Pipeline designers recognize the possibility of a rupture, installing automatic pressure (loss) activated valves at river crossings and equipping booster stations with overpressure shutdown logic.

SCADA systems are also generally fault-tolerant (redundant), and major pipelines may even have a physically separated, alternate-site SCADA system, intended to assume control if the primary SCADA system were disabled. A major pipeline might have field-based personnel who can take local manual control of booster stations and storage terminals, as long as voice communications are available.

A risk assessment also requires assembling previously developed scenarios and ranking them by a combination of their consequence rating and likelihood rating. Table 2 shows how this could be organized; scenarios with severe consequences and a high likelihood of occurring would be the top priority for implementing countermeasures.

Assigning priorities to each matrix element is, to a degree, a business decision and related to the risk tolerance of particular organizations.

A self-insured organization may elect to accept the risk posed by third- and fourth-priority scenarios, rather than investing in countermeasures. An organization with insurance underwriters, however, may be penalized in the form of higher rates if it chooses to ignore lower-ranked scenarios. The US Transportation Safety Administration has also mandated implementation of safety measures to protect critical cyber assets.

Any reasonably likely scenario producing severe consequences would clearly demand action to reduce or eliminate the possible outcome. The business decision comes at the moderate and low severity ratings and low likelihood rankings. A risk-averse organization would probably address risks with moderate, and maybe even low, consequences. ✦

CONSEQUENCE-LIKELIHOOD RANKING MATRIX Table 2

Event likelihood	Consequence ranking			
	Severe	Moderate	Low	Minimal
Highly likely	Top priority	2nd priority	4th priority	–
Probable	2nd priority	3rd priority	–	–
Possible	3rd priority	–	–	–
Unlikely	–	–	–	–

Reference

1. Shaw, T., "Energy Infrastructure Cyber Security: Pipelines—A Step-by-Step Guide for Keeping Pipeline Infrastructure Safe From All Cyber Attacks," Oil & Gas Journal Research Center, 2009.

Equipment/Software/Literature

New tool for exploration operations

New Quadro Plex solutions are suited for scalable visualization professionals who interact with 3D models and analyze large volumes of data.

The visual computing platforms are designed to power a range of ultrahigh resolution and multichannel collaboration environments—ranging from interpretation desktops to visualization walls to network operations centers.

Quadro Plex-based solutions enable exploration specialists to seamlessly run any software application across multiple ultrahigh resolution displays or projectors, facilitating accurate and timely decision making, the company points out.

These flexible solutions are built on the Quadro Plex visual computing system, featuring two Quadro FX 5800 GPUs and 8 GB of memory. By connecting two Quadro Plex systems to a single work station, users can view images at a resolution of 36 megapixels, span visuals across two 4K projectors or eight autosynchronized displays, and drive stereoscopic 3D content for an immersive experience.

These Quadro Plex scalable visualization solutions power environments where high resolution images and real-time data feeds are seamlessly blended for training, simulation, and operations monitoring, the firm notes.

Source: **NVIDIA Corp.,** 2701 San Tomas Expressway, Santa Clar, CA 95050.

New model aids seismic processing

New GeoDepth tomography, a next-generation grid-based velocity model solution, is designed to enable geophysicists to rapidly and confidently update the largest velocity models developed from complex geologic regimes.

Tomography is the newest addition to the GeoDepth software suite, delivering enhanced seismic imaging quality, reduced interpretation uncertainty, and increased productivity.

The GeoDepth tomography solution addresses the computational, interpretational, and acquisitional challenges of updating large and complex velocity models for critical seismic assets. It provides added capacity for handling rich azimuth acquisitions and updating anisotropic parameters in sedimentary layers.

GeoDepth tomography leverages this company's high performance computing infrastructure as well as its interpretation solutions to deliver automatic velocity updates. The solution minimizes iteration cycles by combining rich, high quality ray tracing with new tools that automatically reflect surface picking and prestack residual moveouts.

This seismic processing tool provides the GeoDepth suite with new capabilities that simplify and enhance the velocity modeling process, the firm says.

Source: **Paradigm BV,** Reimeresbeek 2, 1082 AG Amsterdam, the Netherlands.

Services/Suppliers

Sungard,

Wayne, Pa., has named Ben Jackson senior executive vice-president of its new energy and commodities business unit, based in Houston. He succeeds Matt Mandalicini, who was appointed president and chief custom officer of Sungard's higher education unit. Previously, Jackson was COO of Sungard's Kiodex unit. Prior to joining SunGard in 2006, Jackson held executive positions at The Bank of New York, James Martin & Co. (Headstrong), KeyBank, and Andersen (Accenture).


Jackson

Sungard is the world's fifth largest software company. Its energy and commodities unit provides software for commodity trading, risk management, independent valuation, and market data for those firms that trade commodities financially; and straight-through processing, enterprise-wide risk management, scheduling, and logistics for those companies that transact business around physical energy and other commodities.

Schlumberger Ltd.,

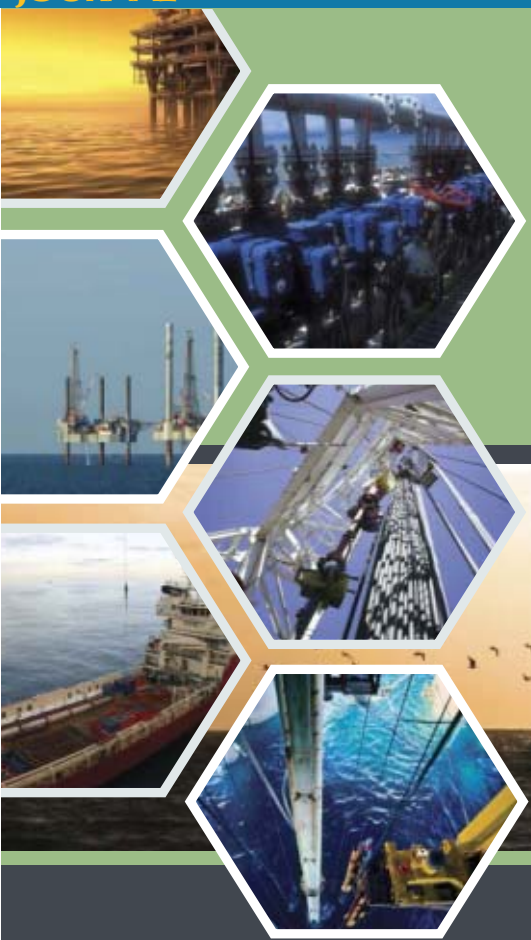
Paris, has signed a joint cooperation agreement with the Universidade Federal do Rio de Janeiro (UFRJ) to build a key international research center on the university's campus. The agreement marks the first research and geosciences center to be located at UFRJ Technology Park. The Schlumberger Brazil Research & Geosciences Center will focus on research and development activities in the deepwater presalt environment, with emphasis on the development of geosciences software for the exploration and production sector, new technologies to meet reservoir challenges in presalt environments, and the creation of a geophysical processing and interpretation center of excellence covering time-lapse seismic and combined electromagnetic and seismic measurements.

Schlumberger is the world's largest supplier of technology, integrated project management, and information solutions to the oil and gas industry.

CGGVeritas,

Paris, has signed a research and development agreement with the Western Australian Energy Research Alliance (WAERA), a prominent oil and gas research alliance within the Asia-Pacific region. WAERA comprises the University of Western Australia, Commonwealth Scientific and Industrial Research Organization, and Curtin University of Technology. The agreement defines a framework to support the rapid identification of opportunities for research, development, consultancy, education, and commercial application of advanced geophysical technologies in the search for, and optimum exploitation of, energy resources. The framework provides formal guidelines for planning, agreeing, and executing individual R&D projects once they have been identified.

CGGVeritas is a leading international pure-play geophysical company delivering a wide range of technologies, services, and equipment (through Sercel) to its broad base of customers mainly throughout the global oil and gas industry.



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Imports of crude and products

	Districts 1-4		District 5		Total US		
	9-18 2009	9-11 2009	9-18 2009	9-11 2009	9-18 2009	9-11 2009	*9-19 2008
	1,000 b/d						
Total motor gasoline	1,028	675	0	26	1,028	701	1,211
Mo. gas. blending comp.	824	523	0	23	824	546	766
Distillate	157	129	28	18	185	147	199
Residual	173	217	0	50	173	267	440
Jet fuel-kerosine	49	42	74	43	123	85	68
Propane-propylene	71	93	8	4	79	97	241
Other	133	472	47	33	180	505	439
Total products	**2,435**	**2,151**	**157**	**197**	**2,592**	**2,348**	**3,364**
Total crude	**8,861**	**7,920**	**933**	**983**	**9,794**	**8,903**	**7,143**
Total imports	**11,296**	**10,071**	**1,090**	**1,180**	**12,386**	**11,251**	**10,507**

*Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Purvin & Gertz LNG netbacks—Sept. 25, 2009

Receiving terminal	Liquefaction plant					
	Algeria	Malaysia	Nigeria	Austr. NW Shelf	Qatar	Trinidad
	$/MMbtu					
Barcelona	5.74	3.72	4.94	3.62	4.28	4.87
Everett	3.02	1.88	2.67	1.97	2.40	3.29
Isle of Grain	2.67	2.08	2.13	1.98	2.10	2.11
Lake Charles	1.63	0.36	1.57	0.52	0.73	1.87
Sodegaura	4.84	7.10	5.10	6.81	6.10	4.20
Zeebrugge	5.11	3.57	4.57	3.47	3.98	4.60

Definitions, see OGJ Apr. 9, 2007, p. 57.
Source: Purvin & Gertz Inc.
Data available in OGJ Online Research Center.

Crude and product stocks

District	Crude oil	Motor gasoline		Jet fuel, kerosine	Fuel oils		Propane–propylene
		Total	Blending comp.[1]		Distillate	Residual	
	1,000 bbl						
PADD 1	14,913	56,537	38,864	12,847	74,250	13,974	4,402
PADD 2	79,279	51,444	24,972	7,878	32,746	1,029	31,063
PADD 3	175,351	71,404	39,508	15,572	49,650	13,588	34,399
PADD 4	14,903	6,271	1,980	583	3,103	238	[1]2,209
PADD 5	51,162	27,453	21,874	9,319	11,005	3,806	—
Sept. 18, 2009	**335,608**	**213,109**	**127,198**	**46,199**	**170,754**	**32,635**	**72,073**
Sept. 11, 2009	**332,753**	**207,700**	**122,891**	**45,152**	**167,793**	**33,902**	**70,671**
Sept. 19, 2008[2]	**290,186**	**178,739**	**92,799**	**37,087**	**125,449**	**35,613**	**55,636**

[1]Includes PADD 5. [2]Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Refinery report—Sept. 18, 2009

District	REFINERY OPERATIONS		REFINERY OUTPUT				
	Gross inputs	Crude oil inputs	Total motor gasoline	Jet fuel, kerosine	Fuel oils: Distillate	Fuel oils: Residual	Propane–propylene
	1,000 b/d						
PADD 1	1,285	1,208	2,320	75	407	116	52
PADD 2	3,161	3,154	2,172	236	866	33	250
PADD 3	7,532	7,313	2,579	705	2,183	280	667
PADD 4	591	567	310	38	187	12	[1]66
PADD 5	2,530	2,491	1,505	381	530	101	—
Sept. 18, 2009	**15,099**	**14,733**	**8,886**	**1,435**	**4,173**	**542**	**1,035**
Sept. 11, 2009	**15,340**	**15,049**	**9,032**	**1,420**	**4,160**	**530**	**1,055**
Sept. 19, 2008[2]	**11,747**	**11,504**	**7,954**	**1,152**	**3,258**	**392**	**585**
	17,644 Operable capacity		**85.6 utilization rate**				

[1]Includes PADD 5. [2]Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Additional analysis of market trends is available through **OGJ Online**, *Oil & Gas Journal's* electronic information source, at http://www.ogjonline.com.

OGJ crack spread

	*9–25–09	*9–26–08	Change	Change, %
	$/bbl			
SPOT PRICES				
Product value	71.77	117.70	–45.93	–39.0
Brent crude	66.74	103.17	–36.43	–35.3
Crack spread	5.03	14.53	–9.50	–65.4
FUTURES MARKET PRICES				
One month				
Product value	71.99	17.46	54.53	312.4
Light sweet crude	68.43	107.32	–38.89	–36.2
Crack spread	3.56	10.13	–6.57	–64.9
Six month				
Product value	76.87	118.70	–41.83	–35.2
Light sweet crude	70.94	106.70	–35.76	–33.5
Crack spread	5.93	12.00	–6.07	–50.6

*Average for week ending.
Source: Oil & Gas Journal
Data available in OGJ Online Research Center.

OGJ GASOLINE PRICES

	Price ex tax 9-23-09	Pump price* 9-23-09	Pump price 9-24-08
	¢/gal		
(Approx. prices for self-service unleaded gasoline)			
Atlanta	203.1	249.6	370.2
Baltimore	208.6	250.5	374.2
Boston	210.6	252.5	370.3
Buffalo	203.6	264.5	365.2
Miami	216.9	268.5	367.2
Newark	209.2	241.8	360.2
New York	198.0	258.9	370.2
Norfolk	204.3	242.7	364.3
Philadelphia	208.8	259.5	372.3
Pittsburgh	209.1	259.8	369.2
Wash., DC	221.1	259.5	367.3
PAD I avg	208.5	255.3	368.2
Chicago	210.0	274.4	404.6
Cleveland	216.3	262.7	373.9
Des Moines	209.0	249.4	367.9
Detroit	215.0	274.4	375.1
Indianapolis	200.7	260.1	369.4
Kansas City	198.3	234.3	368.8
Louisville	216.8	257.7	380.6
Memphis	197.5	237.3	364.2
Milwaukee	210.1	261.4	374.9
Minn.-St. Paul	214.3	258.3	372.2
Oklahoma City	190.0	225.4	359.7
Omaha	186.4	231.7	367.2
St. Louis	193.4	229.4	364.4
Tulsa	187.0	222.4	359.2
Wichita	191.0	234.4	362.1
PAD II avg	202.4	247.6	371.0
Albuquerque	197.2	233.6	364.2
Birmingham	200.3	239.6	362.5
Dallas-Fort Worth	201.2	239.6	350.4
Houston	198.2	236.6	372.3
Little Rock	192.8	233.0	364.1
New Orleans	201.2	239.6	371.6
San Antonio	202.3	240.7	365.8
PAD III avg	199.0	237.5	364.4
Cheyenne	222.3	254.7	351.5
Denver	223.3	263.7	384.4
Salt Lake City	214.3	257.2	367.5
PAD IV avg	220.0	258.6	367.8
Los Angeles	238.0	305.1	373.2
Phoenix	228.6	266.0	357.0
Portland	243.7	287.1	361.8
San Diego	240.0	307.1	382.3
San Francisco	247.0	314.1	391.1
Seattle	245.8	301.7	367.3
PAD V avg	240.5	296.8	372.1
Week's avg.	**210.1**	**255.7**	**369.1**
Aug. avg.	**209.9**	**255.5**	**367.2**
July avg.	**205.6**	**251.2**	**375.3**
2009 to date	**178.1**	**223.7**	--
2008 to date	**310.4**	**354.4**	--

*Includes state and federal motor fuel taxes and state sales tax. Local governments may impose additional taxes.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

REFINED PRODUCT PRICES

	9-18-09 ¢/gal		9-18-09 ¢/gal
Spot market product prices			
Motor gasoline (Conventional-regular)		Heating oil No. 2	
New York Harbor	184.90	New York Harbor	179.12
Gulf Coast	180.15	Gulf Coast	178.62
Los Angeles	183.65	Gas oil	
Amsterdam-Rotterdam-Antwerp (ARA)	184.84	ARA	182.41
Singapore	188.07	Singapore	182.26
Motor gasoline (Reformulated-regular)		Residual fuel oil	
New York Harbor	182.03	New York Harbor	155.29
Gulf Coast	182.28	Gulf Coast	159.24
Los Angeles	195.15	Los Angeles	169.61
		ARA	159.35
		Singapore	163.26

Source: DOE Weekly Petroleum Status Report.
Data available in OGJ Online Research Center.

BAKER HUGHES RIG COUNT

	9-25-09	9-26-08
Alabama	5	5
Alaska	6	11
Arkansas	40	59
California	21	47
Land	20	46
Offshore	1	1
Colorado	46	109
Florida	1	3
Illinois	1	1
Indiana	3	2
Kansas	26	12
Kentucky	9	12
Louisiana	153	176
N. Land	103	85
S. Inland waters	7	14
S. Land	15	26
Offshore	28	51
Maryland	0	0
Michigan	0	2
Mississippi	10	16
Montana	3	10
Nebraska	0	0
New Mexico	47	91
New York	3	8
North Dakota	48	75
Ohio	8	10
Oklahoma	76	202
Pennsylvania	54	27
South Dakota	0	2
Texas	376	950
Offshore	2	11
Inland waters	0	0
Dist. 1	16	25
Dist. 2	10	38
Dist. 3	39	61
Dist. 4	31	87
Dist. 5	69	189
Dist. 6	47	141
Dist. 7B	11	30
Dist. 7C	23	69
Dist. 8	64	129
Dist. 8A	14	26
Dist. 9	24	44
Dist. 10	26	100
Utah	13	43
West Virginia	20	28
Wyoming	38	80
Others—HI-1; NV-2; OR-1; TN-1; VA-5	10	14
Total US	**1,017**	**1,995**
Total Canada	**228**	**465**
Grand total	**1,245**	**2,460**
US Oil rigs	297	423
US Gas rigs	710	1,559
Total US offshore	31	69
Total US cum. avg. YTD	**1,083**	**1,871**

Rotary rigs from spudding in to total depth.
Definitions, see OGJ Sept. 18, 2006, p. 42.

Source: Baker Hughes Inc.
Data available in OGJ Online Research Center.

SMITH RIG COUNT

Proposed depth, ft	Rig count	9-25-09 Percent footage*	Rig count	9-26-08 Percent footage*
0-2,500	50	2.0	93	6.4
2,501-5,000	72	62.5	131	48.8
5,001-7,500	108	23.1	270	16.6
7,501-10,000	203	4.4	485	2.4
10,001-12,500	212	12.7	441	1.5
12,501-15,000	147	0.6	361	—
15,001-17,500	134	—	153	—
17,501-20,000	58	—	88	—
20,001-over	34	—	28	—
Total	**1,023**	**11.1**	**2,001**	**6.4**
INLAND	12		28	
LAND	970		1,977	
OFFSHORE	36		45	

*Rigs employed under footage contracts.
Definitions, see OGJ Sept. 18, 2006, p. 42.

Source: Smith International Inc.
Data available in OGJ Online Research Center.

OGJ PRODUCTION REPORT

	[1]9-25-09	[2]9-26-08
	1,000 b/d	
(Crude oil and lease condensate)		
Alabama	21	21
Alaska	672	681
California	657	655
Colorado	64	66
Florida	6	5
Illinois	29	27
Kansas	108	116
Louisiana	1,404	311
Michigan	18	18
Mississippi	62	60
Montana	90	86
New Mexico	160	157
North Dakota	191	190
Oklahoma	179	181
Texas	1,385	1,075
Utah	61	62
Wyoming	146	146
All others	65	73
Total	**5,318**	**3,930**

[1]OGJ estimate. [2]Revised.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

US CRUDE PRICES

	9-25-09 $/bbl*
Alaska-North Slope 27°	65.67
South Louisiana Sweet	67.75
California-Kern River 13°	57.25
Lost Hills 30°	65.90
Wyoming Sweet	57.27
East Texas Sweet	62.00
West Texas Sour 34°	57.50
West Texas Intermediate	62.50
Oklahoma Sweet	62.50
Texas Upper Gulf Coast	55.50
Michigan Sour	54.50
Kansas Common	61.25
North Dakota Sweet	52.25

*Current major refiner's posted prices except North Slope lags 2 months. 40° gravity crude unless differing gravity is shown.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

WORLD CRUDE PRICES

$/bbl[1]	9-18-09
United Kingdom-Brent 38°	68.22
Russia-Urals 32°	67.43
Saudi Light 34°	66.78
Dubai Fateh 32°	68.60
Algeria Saharan 44°	68.82
Nigeria-Bonny Light 37°	70.28
Indonesia-Minas 34°	70.69
Venezuela-Tia Juana Light 31°	68.48
Mexico-Isthmus 33°	68.37
OPEC basket	68.59
Total OPEC[2]	68.05
Total non-OPEC[2]	67.99
Total world[2]	68.02
US imports[3]	67.65

[1]Estimated contract prices. [2]Average price (FOB) weighted by estimated export volume. [3]Average price (FOB) weighted by estimated import volume.
Source: DOE Weekly Petroleum Status Report.
Data available in OGJ Online Research Center.

US NATURAL GAS STORAGE[1]

	9-18-09	9-11-09	9-18-08	Change, %
	bcf			
Producing region	1,126	1,110	807	**39.5**
Consuming region east	1,917	1,876	1,799	**6.6**
Consuming region west	482	472	409	**17.8**
Total US	**3,525**	**3,458**	**3,015**	**16.9**
	July 09	**June 08**	**Change, %**	
Total US[2]	**3,086**	**2,516**	**22.7**	

[1]Working gas. [2]At end of period.
Source: Energy Information Administration
Data available in OGJ Online Research Center.

Statistics

PACE REFINING MARGINS

	July 2009	Aug. 2009	Sept. 2009	Sept. 2008	– 2009 vs. 2008 – Change	Change, %
			$/bbl			
US Gulf Coast						
West Texas Sour	6.97	7.34	3.31	23.44	–20.13	–85.9
Composite US Gulf Refinery	8.92	9.24	4.63	23.96	–19.33	–80.7
Arabian Light	5.72	7.75	0.38	22.35	–21.97	–98.3
Bonny Light	3.32	2.76	0.82	19.33	–18.52	–95.8
US PADD II						
Chicago (WTI)	7.58	7.82	4.28	31.20	–26.92	–86.3
US East Coast						
NY Harbor (Arab Med)	4.50	7.06	0.67	12.57	–11.90	–94.7
East Coast Comp-RFG	5.81	7.19	3.60	16.38	–12.78	–78.0
US West Coast						
Los Angeles (ANS)	14.03	15.20	16.61	12.87	3.74	29.0
NW Europe						
Rotterdam (Brent)	1.28	1.50	1.31	8.10	–6.79	–83.9
Mediterranean						
Italy (Urals)	–0.72	–0.21	–0.22	8.92	–9.14	–102.4
Far East						
Singapore (Dubai)	0.79	1.64	1.40	3.68	–2.28	–61.9

Source: Jacobs Consultancy Inc.
Data available in OGJ Online Research Center.

US NATURAL GAS BALANCE DEMAND/SUPPLY SCOREBOARD

	July 2009	June 2009	July 2008	July 2009-2008 change	Total YTD 2009	Total YTD 2008	YTD 2009-2008 change
				bcf			
DEMAND							
Consumption	1,643	1,524	1,709	-66	13,563	14,176	-613
Addition to storage	413	449	430	-17	2,106	1,858	248
Exports	68	67	66	2	632	603	29
Canada	36	37	31	5	427	354	73
Mexico	28	28	30	-2	184	222	-38
LNG	4	2	5	-1	21	27	-6
Total demand	**2,124**	**2,040**	**2,205**	**-81**	**16,301**	**16,637**	**-336**
SUPPLY							
Production (dry gas)	1,775	1,737	1,787	-12	12,289	12,000	289
Supplemental gas	5	2	4	1	35	29	6
Storage withdrawal	83	62	88	-5	1,843	2,221	-378
Imports	303	283	322	-19	2,182	2,328	-146
Canada	257	231	287	-30	1,878	2,111	-233
Mexico	2	1	4	-2	18	13	5
LNG	44	51	31	13	286	204	82
Total supply	**2,166**	**2,084**	**2,201**	**-35**	**16,349**	**16,578**	**-229**

NATURAL GAS IN UNDERGROUND STORAGE

	July 2009	June 2009	May 2009	July 2008	Change
			bcf		
Base gas	4,266	4,260	4,253	4,228	38
Working gas	3,086	2,752	2,367	2,516	570
Total gas	**7,352**	**7,012**	**6,620**	**6,744**	**608**

Source: DOE Monthly Energy Review.
Data available in OGJ Online Research Center.

WORLDWIDE NGL PRODUCTION

	June 2008	May 2008	6 month average production 2009	6 month average production 2008	Change vs. previous year Volume	Change vs. previous year %
			1,000 b/d			
Brazil	65	84	80	87	–7	–8.3
Canada	486	462	564	651	–87	–13.3
Mexico	363	382	371	369	2	0.6
United States	1,901	1,934	1,842	1,843	–2	–0.1
Venezuela	200	200	200	200	—	—
Other Western Hemisphere	191	200	204	195	9	4.5
Western Hemisphere	**3,206**	**3,262**	**3,261**	**3,345**	**–84**	**–2.5**
Norway	241	258	277	292	–15	–5.2
United Kingdom	132	139	142	177	–35	–20.0
Other Western Europe	10	10	10	10	—	4.9
Western Europe	**383**	**407**	**428**	**478**	**–50**	**–10.5**
Russia	428	426	411	420	–9	–2.1
Other FSU	150	150	150	150	—	—
Other Eastern Europe	14	15	15	16	–1	–4.0
Eastern Europe	**592**	**591**	**576**	**586**	**–10**	**–1.6**
Algeria	338	338	341	354	–14	–3.8
Egypt	70	70	70	70	—	—
Libya	80	80	80	80	—	—
Other Africa	131	131	131	130	1	0.5
Africa	**619**	**619**	**622**	**634**	**–13**	**–2.0**
Saudi Arabia	1,482	1,411	1,372	1,440	–68	–4.7
United Arab Emirates	250	250	250	250	—	—
Other Middle East	836	836	835	877	–41	–4.7
Middle East	**2,497**	**2,462**	**2,435**	**2,566**	**–131**	**–5.1**
Australia	82	71	67	63	4	6.3
China	650	650	650	620	30	4.8
India	—	—	—	—	—	—
Other Asia-Pacific	169	169	169	179	–10	–5.7
Asia-Pacific	**901**	**890**	**886**	**862**	**24**	**2.8**
TOTAL WORLD	**8,269**	**8,266**	**8,230**	**8,473**	**–243**	**–2.9**

Totals may not add due to rounding.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

OXYGENATES

	July 2009	June 2009	Change	YTD 2009	YTD 2008	Change
			1,000 bbl			
Fuel ethanol						
Production	22,577	20,822	1,755	140,873	120,227	20,646
Stocks	14,294	13,903	391	14,294	13,186	1,108
MTBE						
Production	1,566	1,561	5	10,463	11,169	–706
Stocks	659	811	–152	659	1,252	–593

Source: DOE Petroleum Supply Monthly.
Data available in OGJ Online Research Center.

US COOLING DEGREE-DAYS

	Aug. 2009	Aug. 2008	Normal	2009 % change from normal	Total degree-days Jan. 1 through Aug. 31 2009	2008	Normal	% change from normal
New England	208	86	146	42.5	359	436	395	–9.1
Middle Atlantic	251	154	205	22.4	553	645	592	-6.6
East North Central	165	162	197	–16.2	475	572	641	–25.9
West North Central	191	221	255	–25.1	633	714	828	–23.6
South Atlantic	439	389	393	11.7	1,589	1,582	1,497	6.1
East South Central	360	361	376	–4.3	1,281	1,311	1,276	0.4
West South Central	555	509	527	5.3	2,139	2,019	1,929	10.9
Mountain	325	336	302	7.6	1,084	1,076	1,017	6.6
Pacific	239	263	193	23.8	667	710	538	24.0
US average*	**309**	**281**	**290**	**6.6**	**1,003**	**1,034**	**986**	**1.7**

*Excludes Alaska and Hawaii.
Source: DOE Monthly Energy Review.
Data available in OGJ Online Research Center.

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The Editor's Perspective

by Bob Tippee, Editor

production work along the Amazon River that Chevron never conducted.

It's 31% of Chevron's total shareholders' equity. It's more than half of Ecuador's gross domestic product.

Chevron inherited the fight when it acquired Texaco in 2001. Texaco had participated in a consortium that produced oil in Ecuador until its concession ended in 1992. A Texaco unit had been operator until the state-owned oil company replaced it in 1990. Chevron says Texaco spent $40 million for its share of environmental clean-up and was released from liability by the government. It also says the state company, Petroecuador, created the environmental problems evident now.

Alleging corruption of Ecuadorian courts and prejudice of the country's president, Chevron has filed for international arbitration (OGJ Online, Sept. 25, 2009).

Lawyers for the Ecuadorian plaintiffs say outcome of the arbitration, related to a treaty between governments, won't affect the legal case, which involves individuals and a company. In public, Chevron has steadfastly defended its position, dedicating part of its web site to reports of developments and not mincing words.

Plaintiffs' attorneys and the allied activist group Amazon Watch snipe at every move Chevron makes, of course. The spearhead is New York lawyer Steven Donzinger, a law school friend of US President Barack Obama who helped raise funds for his old buddy's political campaign. So this isn't quite David vs. Goliath.

Donzinger threatens to seize Chevron assets if plaintiffs prevail. If damages approach their potential, logistics of that maneuver would be interesting.

A better word than "interesting" in this case, however, is "unreal."

Twenty-seven billion dollars at stake in a tiny court in Ecuador. From shareholders of a company that never worked there.

In fact, "unreal" doesn't do justice to this exercise in gold-digging. "Preposterous" seems more appropriate.

(Online Sept. 25, 2009; author's e-mail: bobt@ogjonline.com)

Market Journal

by Sam Fletcher, Senior Writer

Horsnell: US policy will shift oil markets

Commodities market regulation in the US seems to be moving towards higher capital requirements and bureaucratization with relatively little impact on prices in the long run, said Paul Horsnell, managing director and head of commodities research at Barclays Capital in London. However, he warned, "Expect the center of gravity of world oil trading to move further away from US markets."

After a long period of regulatory fog and uncertainty, more clarity may be about to emerge as to the revised regulatory backdrop for US commodities markets. "The main impact, in our view, is more likely to be on the structure, location, and composition of and the hedging costs in markets rather than…any lasting impact on the price levels those markets generate," Horsnell said. "Whether or not there are short-term price effects within temporarily disorderly markets depends in large part on how the changes are presented and announced." It is still "a bit early" to tell "which style of announcement will be applied to regulatory changes in commodities and, hence, whether there will be any short-term price distortions."

However, he said, the nature of the regulatory and bureaucratic structures likely to be imposed on US commodities markets is becoming clearer. Recent testimony by Commodity Futures Trading Commission Chairman Gary Gensler in Washington seems "to involve higher margining requirements, a broadening of the regulatory ambit across over-the-counter markets, and a bureaucraticization and centralization of those markets." Horsnell noted, "Gensler's testimony did not link change in any way to the operation, participants, or performance of commodities markets. Instead, he linked change to the overhaul of the US financial system as a whole and in its entirety after what he described as its failing of the American people 1 year ago. The arguments based on specific commodities-based criteria have then, it seems, been abandoned in favor of arguments drawn from a generalized approach to greater regulation of financial markets in their entirety."

A 'philosophic mutation'

Horsnell said, "In other words, this seems to have mutated into regulation born of a general regulatory philosophy rather than being driven by the identification and attempted correction of specific market failures or distortions in specific commodities markets. The danger in that evolution is that the move to a more dogma-based motivation means that the regulatory process in the future may be less concerned by the nature of the distortions it throws up, given that it is the imposition of the regulation itself rather the correction of any specific distortion that has now become the main objective. That would imply regulation with limited market-based benchmarks to judge its own effectiveness or need, and that would not be a recipe for any flexible, pragmatic, or volatility-reducing regime."

He said, "Other than the danger of a short-term disorderly market should implementation prove unexpectedly clumsy, we would not expect to see steady-state oil prices change as a result of the new regulation. In an industry that now needs more than $60/bbl to operate with any sustainability, prices cannot stay too much lower than current levels without stoking future price shocks."

Meanwhile, Horsnell said, "We would expect some changes to the structure of the oil market. We would expect to see a degree of liquidity migrate away from US exchanges. We expect to see increasing costs for some hedging operations, potentially leaving commercial operations more exposed as they face a new and less favorable trade-off between risk reduction and its cost. Indeed, the scope for some types of risk management in US markets is likely to be truncated by cost and by transparency obligations, especially those with longer execution times in less liquid parts of the curve. Transparency is not necessarily a good objective to have in low volume areas of the market, if it means that even less volume can be traded before markets move severely against those engaged in the execution of risk management."

Horsnell said, "The drive towards greater transparency of transactions does not always provide a benefit in those circumstances, and in those less liquid areas the danger is that liquidity will die away completely, leaving the market and commercial companies to carry a greater degree of time and basis risks."

In other news, the latest statement of Saudi Arabia's short and medium-term policies provides "a further signal" that $70-80/bbl for crude is considered a comfortable range for now, Horsnell said. Ali al-Naimi, Saudi Arabia Minister of Petroleum, indicated prices above $70/bbl are necessary to maintain investment and keep the oil market balanced over the longer term.

(Online Sept. 28, 2009; author's e-mail: samf@ogjonline.com)

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Plugging and Abandoning Hurricane-Damaged Wells

Vented Inflatable System Eliminates Gas Bubbles, Enables Successful Cement Plugs

Many hurricane-damaged wells in the Gulf of Mexico have to be permanently plugged and abandoned. Operators have discovered that many of these wells are bubbling, which creates challenges when placing cement barriers in the wells.

Gas Bubbles Passing Through Microannuli

Inflatable packers such as Baker Oil Tools' Production Injection Packer (PIP), deployed as a pressure sealing base on which a cement plug is placed, is often a suitable fix for this problem. However, gas bubbles sometimes find a way around the PIP and work their way through the cement, creating microannuli even after the cement sets up. These bubbles travel through microscopic pits or fissures in the old casing. This was the challenge an operator faced in a High Island well with 26-in., 125 lbf casing.

Vented PIP System

To solve this problem reliably and economically, Baker Hughes developed the Vented PIP System, a new method of stopping the flow of bubbles. The system consists of a PIP (with a ball on seat below it), a length of vent tubing above it, and a mechanical disconnect on top of that.

Bubbles in Well Stopped Immediately

Once the system was set at depth, bubbles in the well stopped immediately. Simultaneously, a substantial flow of gas was observed through the work string at surface. The operator then ran a grout string (small work string) beside the primary work string to a depth just above the inflated element. Cement was then pumped through the grout string on top of the PIP. A cement volume was pumped that equaled about 50 ft in the annulus between the 26-in. casing ID and the OD of the 2 7/8-in. tubing. While this cement cured, the vent tubing and work string were kept open to vent the gas to surface. This prevented gas buildup below the PIP and kept bubbles from affecting the cement job. Once the cement had completely cured, a cast iron bridge plug was run through the primary work string and set in the vent tubing above the PIP. This resulted in a permanently plugged well.

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