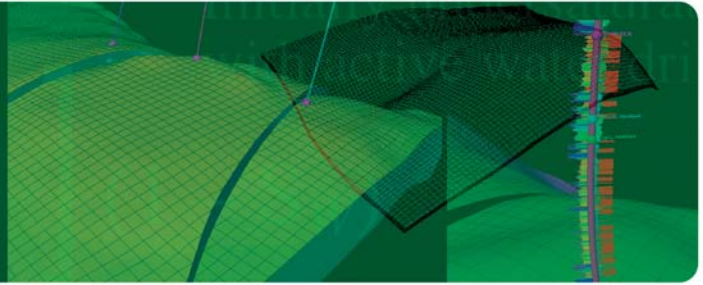


# RESERVOIR SOLUTIONS



A quarterly publication of Ryder Scott Petroleum Consultants

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## OPEC adopts SPE reserves definitions for reporting



The biggest industry players say they will play by the rules, that is more modern rules.

Claiming almost 70 percent of the world's proved oil and gas reserves, the Organization of Petroleum Exporting Countries will classify and report those quantities in accordance with 2007 Society of Petroleum Engineers definitions, said **John Ritter**, chairman of the SPE Oil and Gas Reserves Committee.

OPEC member countries had reported reserves using definitions of the American Petroleum Institute that are basically unchanged from the 1960s. Considering high oil and gas prices and questions about supply, OPEC's use of modern definitions is welcome news for those leading global efforts for worldwide

standards.

SPE adopted proved reserves definitions similar to API's in 1964 and revised them most recently in 1997. OPEC members report their proved reserves to the organization which publishes them in the OPEC Annual Statistical Bulletin.

"We have worked for two years on this. It is very positive and will give us an idea of resources around the world," Ritter told a capacity audience at the Second Annual Ryder Scott Reserves Conference on May 5. An April 17 *Oil and Gas Journal* article by **Paula Ditrack** quoted the OPEC secretariat as saying that "OPEC members use proved oil and gas reserves as defined by SPE for internal OPEC studies and reports."

## Roesle is chairman, Magoto joins board, Hamlin promoted



Roesle



Magoto



Hamlin

**Don Roesle**, CEO at Ryder Scott, is the new chairman replacing **Ron Harrell**, who became chairman emeritus and advisor to the board earlier this year. Roesle will continue in a COO role without the title.

**Joe Magoto** joined the board of directors. He began his tenure at Ryder Scott in 1978 after working for Exxon Co. USA for five years. Magoto has more than 30 years of reservoir and production engineering experience. He has served on corporate audit teams as an independent advisor recommending improvements in reserves management and audit processes.

Magoto has been a group leader, supervising evaluation teams on integrated projects. In addition, he has headed the management advisory services and been involved in field development studies, reserves and economic evaluations and acquisition and divestiture work.

**John Hamlin** was promoted to managing senior vice president and group leader to replace **Fred Richoux**, who continues as executive vice president.

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# SPE OGRC chairman details progress on 2007 reserves definitions at Ryder Scott reserves conference

**John Ritter**, chairman of the SPE Oil and Gas Reserves Committee, said the “most key document” in reserves that SPE plans to publish — a handbook of practical examples using the 2007 reserves definitions — may eventually leverage references like the Canadian Oil and Gas Evaluation Handbook Vol. 2. “Even though COGEH is regulatory in perspective, unlike SPE, it offers a great set of examples,” he remarked.

Ritter told attendees at the May 5 Ryder Scott reserves conference that the committee had not finalized any of its work on the 2007 definitions or on the handbook, to come later, and that the OGRC draft documents were works in progress at very early stages of the approvals process.

He said that the industry comment period would begin after a draft of the proposed definitions on reserves and resources is posted on the SPE Web site likely in October.

OGRC planned to present the new definition set to the SPE board in September.

Also, OGRC plans to release estimating and auditing standards as part of the 2007 revisions. In January, SPE finalized a glossary of terms, which is posted on the Web site at [www.spe.org](http://www.spe.org).

Ritter said that OGRC found an ambiguity between unproved reserves and contingent resources that has led to inconsistencies. The committee plans to clarify the relationship between the two for better portfolio management. Other areas for revamping include the following:

- Confusion between commercial and technical certainty
- Misalignment—Focus on proved current conditions but project decisions based on 2P forecast conditions.
- Lack of Clarity—Guidelines based on incremental approach but business uses scenario approach.
- Focus too narrow—Buoyancy-based rules do not apply to unconventional resources.

Ritter also said that SPE is

investigating how to make further classifications within each of the proved developed and proved undeveloped categories for use in portfolio analysis.

SPE is working on revisions to probabilistic analysis, but will not issue application examples in 2007. “We may clarify some of the differences between normal and lognormal distributions and how they will be captured in the definitions,” he remarked. Ritter added that the new SPE guidelines will better identify the relationship between “reasonable certainty” in deterministic methods and P90, P50 and P10 used in probabilistic methods.

He remarked that SPE has an opportunity to bring some clarity to issues involving the number of years of future production used in estimates. Ritter said that proved reserves figures, such as the 175 billion barrels for the Canadian oil sands and 238 billion barrels for the Orinoco region, should have a reasonable R/P (reserves over annual production) which yields years of production from first

*Please see SPE on next page*

### Publisher's Statement

*Reservoir Solutions* newsletter is published quarterly by Ryder Scott Company LP. Established in 1937, the reservoir evaluation consulting firm performs hundreds of studies a year. Ryder Scott multidisciplinary studies incorporate geophysics, petrophysics, geology, petroleum engineering, reservoir simulation and economics. With 110 employees, including 66 engineers and geoscientists, Ryder Scott has the capability to complete the largest, most complex reservoir-evaluation projects in a timely manner.

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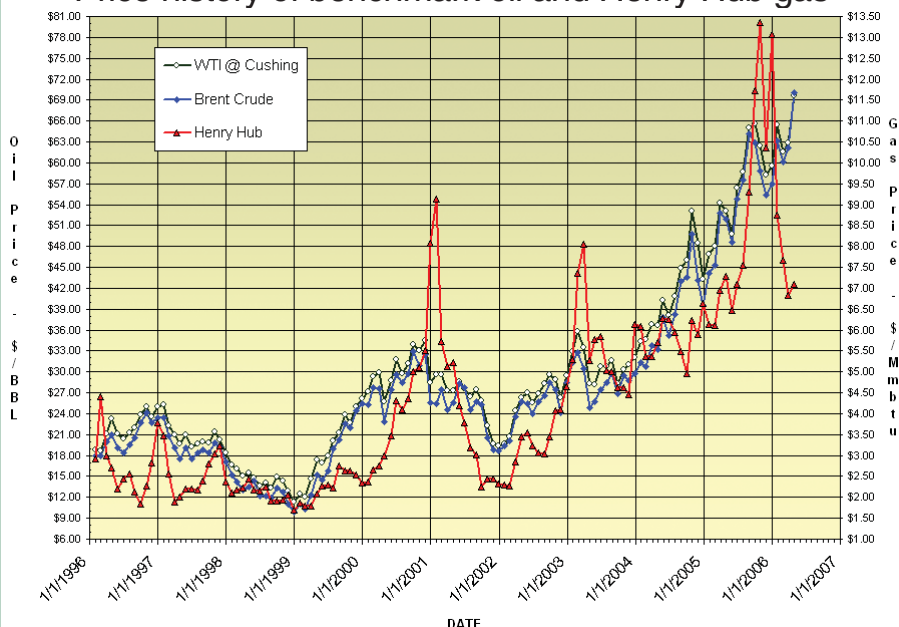
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Price history of benchmark oil and Henry Hub gas



The historical price chart shows published, monthly-average, cash market prices for WTI crude at Cushing (NYMEX), Brent crude and Henry Hub gas.



## Panel gives updates on education

At the Ryder Scott reserves conference, representatives from SPEE, AAPG and the WPC discussed their jointly sanctioned reserves education program leading to the first course—a short course on geological practices at the AAPG annual meeting in April—while the SPE representative detailed society efforts in education paralleling the cooperative efforts.

**Daniel J. Tearpock**, who presented the short course, told conference attendees that investment in independents is high not because of confidence in reserves estimates but because of \$70 barrel oil. “Independents and smaller companies may not have the resources to provide reserves training,” he said.



Ron Harrell moderates session with panelists (from left) Mike Black, Dan Tearpock and Stuart Filler at May 5 conference.

*SPE—Cont. from Page 2*

production to final depletion.

### Alphabet soup

The International Accounting Standards Board, which plans to work with U.S. FASB on harmonizing oil and gas accounting rules by 2009, is reviewing reserves definitions in the extractive industries, namely those of SPE and of the minerals industry’s Combined Reserves International Reporting Standards Committee. “Originally, IASB was looking for a set of definitions to apply to the extractive industries as a whole, but that was a little too much to achieve for now, so they have stepped back and are looking at how SPE definitions apply as well as the mining definitions,” said Ritter.

Encouraged by IASB, SPE has worked with CRIRSCO as well as the United Nations Framework Classification for Energy and Mineral Resources, which uses a McKelvey box scheme to classify feasibility of economic recovery and degree of geological certainty. Ritter said that in the 1950s, one set of definitions applied to mining and petroleum, but that set diverged during that time. CRIRSCO and SPE now plan to update a joint document comparing their respective reserves and resources classifications that will be reviewed by stakeholders IASB and UNECE.

CRIRSCO mineral definitions do not include a possible category, but instead uses the term, inferred resources. Like the petroleum industry, mining uses base-case economic projections with forward prices and costs for proved plus probable reserves, “but how they are defined is fundamentally different,” said Ritter. Also, ironically, the use of probabilistic methods in the mining industry is very limited, he said, even though geostatistics originated in mining.

SPE and CRIRSCO are also jointly developing a

Tearpock, representing AAPG, gave example reserves writedowns caused by a lack of knowledge, including an inflated estimate caused by using incorrect thickness from a deviated well in a dipping bed and an assignment of proved reserves based on a seismic amplitude in an undrilled fault block.

“A sound training initiative for geoscience and engineering reserves evaluators is a plausible solution for restoring investor confidence,” said Tearpock.

**Mike Black**, chairman of the SPE reserves education committee, said his group is organizing reserves events for the 2006 annual meeting in October, 2007 Hydrocarbon Economics and Evaluation Symposium and other SPE sessions and workshops. He added that the SPE will redesign its Web site and add reserves content.

**Stuart Filler**, a director at SPEE, said his organization would sponsor the second course, also on geoscience, at the SPEE annual meeting in June and expected endorsement by AAPG and WPC. “No firm arrangements have been made by SPE to endorse classes currently scheduled,” he remarked.

**Anibal Martinez**, the WPC representative, briefed the audience on WPC efforts that included support for the certification of evaluators through testing, which failed to be approved by AAPG and SPEE.

case study focusing on bitumen reserves in western Canada to illustrate mapping and to determine overlaps between the two systems, both of which are used there.

Ritter said that the SEC has indicated that public pressure is the only way that reserves reporting rules will be changed and that it won’t happen overnight. “The CERA recommendation could have a positive impact,” Ritter remarked.



Petro-Canada mines (top) and drills in the Canada oil sands. SPE and CRIRSCO are developing an unspecified case study to compare mining and E&P reserves classifications.

## Hobbs' solution: A single SPE number for reserves

At the Ryder Scott reserves conference, David Hobbs, a consultant and former managing director at Cambridge Energy Research Associates, said that restoring credibility to reserves disclosures will help ease concerns about future supplies.



“This period of high oil prices and supply uncertainty has people asking is the world about to run out of oil. The market is worried about the long-term availability of reserves because it doesn't have visibility about what is there,”

he said. “The short-term futures market hasn't risen much, but the long-term market has.”

Hobbs quick and easy solution: “Forget about what has happened the past 30 years and use a single number.”

He said that industry has seen signs that Russia has finally recognized that the ABC1 reserves classification system is not the best way to disclose reserves while the International Accounting Standards Board and the United Nations, by working with the Society of Petroleum Engineers, are moving in the right direction.

“It is beholding on everyone in this business to help drive toward that single standard so all become



The Ormen Lange field, facilities pictured here, “shook confidence among ...investors more than any others because there were nine different numbers for reserves,” said Hobbs.

sufficiently locked together and no individual national regulator will have the moral authority to be able to undo that integration,” Hobbs said. “That will remove the level of uncertainty that is currently being seen through high oil and gas prices.”

He said that the industry has managed to undermine the credibility of reserves numbers it reports because it started reporting several numbers. As an example, Hobbs pointed to the controversy two years ago involving reserves bookings from the Ormen Lange field.

“We should avoid a repeat of Ormen Lange. That one asset shook confidence among the media and investors more than any others because there were nine different numbers for reserves quoting different standards and levels of uncertainties,” he said. “Investors can only deal with one number at a time.” Hobbs added that it is now not uncommon for oil

companies to talk about reserves under SEC definitions, SPE definitions, proved plus probable, entire resource base, etc. “People are forced to make financial judgments on the back of the disclosed numbers without any idea of the relevant numbers that they should be looking at,” he remarked.

Hobbs cited estimates that \$6 trillion will be invested in the E&P industry over the next 25 years, saying that the confidence underlying that investment will not be based on short-term, high

oil prices. “The confidence of markets to provide that capital will come only if those investors can rely on disclosures,” he said.

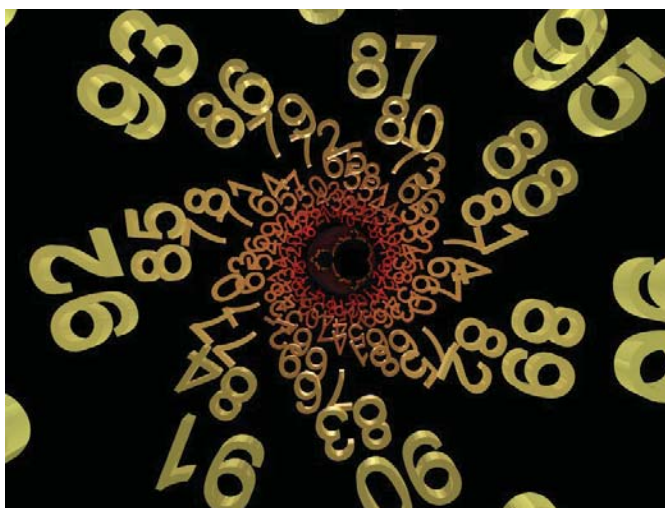
Hobbs urged the industry to begin to get to the point where it sees differences of interpretation rather than differences in standards. “Steps today will lead to greater visibility and remove some uncertainty about the longer-term future,” he remarked.

### Peak oil debate

Those disputing the theory that oil production has peaked argue that today's prices are transitory and that a short-term capacity shortage is responsible for bottlenecks and high prices. Hobbs is in that camp.

“This is the fifth time that policy in the U.S. has been governed by the question, are we about to run out of oil? It is a terribly seductive message to say that prices are high, therefore we are about to run out of oil,” he said.

Hobbs scoffed at those he views as political opportunists. “What can politicians do in the short





term faced with incredibly high and uncertain oil prices? The first thing they do is ensure that no pulpit is left unpreached in. The second thing they do is to talk about obscene profits made by oil companies in absolute terms and not in terms of return on capital.”

### Why modernize?

He pointed to four major changes since the SEC reserves-reporting rules of 1978, remarking that “the only valid option is to drag the regulatory disclosures kicking and screaming into the 21<sup>st</sup> century.”

■ **Globalization of industry**—In 1978, two-thirds of registrants’ reserves were in the United States. Today that number is less than 20 percent.

■ **Technology moving exponentially**—The industry has advanced technology to the point that it is unrecognizable from technology of 30 years ago. “We get more information per physical intervention but are not allowed to use that information under SEC rules,” said Hobbs.

■ **More large-scale projects**—Since 1978, E&P projects have dramatically increased in scope and number. “What an enormous achievement it was to develop the Northern North Sea and the Sullom Voe infrastructure,” said Hobbs. “To develop the Forties field and the Cruden Bay infrastructure, the Alaskan infrastructure—these are projects of such an epoch scale that everyone was aware of the enormous challenge being undertaken. Today, if you try and get someone excited about a \$3 ½ million floater offshore Nigeria, people will yawn. It is extraordinary that we take for granted an anatomy of projects that would make your eyes pop thirty years ago.”



Forties field

■ **Commoditization of markets** – When the 1978 rules were put in place, regulators thought that oil prices would only change as a result of regulation or active government. Gas prices had not yet been deregulated in any meaningful way and there was no global market for oil or gas.

Hobbs suggested that regulators recognize that commodity prices are not a long-term constant and change the rules for prices used in reserves filings.

To reform the system of reserves disclosures, Hobbs recommended the following measures:

■ **Separate measurements of compliance with setting the rules**— In most regulatory regimes, the rules are not set by those who monitor compliance and do the enforcement. “It is not an accident that police are separate from lawmakers who are separate from the judiciary. It is a system that works pretty well,” Hobbs said.

■ **Modernize the rules** – Accept that the single most globally resilient extensive set of definitions is the SPE set. “There seems to be inevitability among the IASB and UN that they are not going to be able to

come up with any more credible or robust definitions than those of SPE. The simplest, quickest way to arrive at a result, rather than go through years of consultation, is to bite the bullet and say we are going to treat SPE as an authority,” he said.

■ **Accept subsequent modernizations**—SPE revisions to its definitions should be reviewed and if acceptable, adopted on a continuing basis by regulators. Hobbs said that “if the SEC simply lurches to the modern day by adopting the SPE definitions that would merely store up for the future the same issue as the agency has had by sticking to their definitions for the last 28 years.” His solution is for the SEC to accept the changes unless it argues sufficiently convincingly not to adopt continuing modernization. In that way, the updated SPE guidelines would continue to be treated as authoritative.



Hobbs dismissed the notion that regulators create bureaucratic speed bumps that make it impossible for change. “If the regulators had the will to do it, they could do it terribly easily,” he remarked. “Until a few years ago, every ATM was treated under banking regulations as a bank branch and had to do the same paperwork and had the same clearances.

Regulators changed that,” he said.

Hobbs recommended that the SEC rewrite Regulation S-X to “remove one or two of the shining inconsistencies with SPE.”

He recognized that evaluators have to contend with the duplicity of reporting both SEC-case proved reserves and 2P reserves used in project planning. “When regulations fail to draw a correct picture of an industry that they are seeking to regulate, you run into frustrations. By nature, engineers like truth and dislike dishonesty. That is the psyche of an engineer. It must be agony to be constrained by regulation to report numbers that you know aren’t the same numbers that you yourself place credibility in when you propose to companies that they make enormous investments.”



He added, “It is not reasonable for regulations to put engineers in that position. Ethics should not require a lot of thinking. It should be ingrained and instinctive. Yet issues are raised in that regulations are not a true reflection of the industry.”

## Report on 2007 audit, evaluation standards: A look inside the “kitchen”

**Ron Harrell**, chairman emeritus at Ryder Scott, said SPE plans to release new standards for auditing and evaluating reserves in 2007 that includes a proposal to beef up the qualifications for a reserves evaluator and auditor. SPE will also consider clarifying other issues not fully addressed in its 2001 standards, such as acceptable tolerances in a reserves audit, standards for entity reserves reports, guidance on performance and volumetric analysis and use of analogs under regulatory guidelines.

Harrell, a member of an SPE working committee to update reserves audit and evaluation standards, said that his presentation at the Ryder Scott reserves conference in May was only a progress update. “No approvals have been made at any level to the draft,” he remarked. “However, you can look inside the kitchen and see us making sausage. Just keep the door closed.”

Harrell said that the need for change arose from the influence of new technology, non-U.S. fiscal regimes and greater corporate governance and regulatory compliance requirements. “There are a lot more eyes looking at who we are and what we do,” he remarked, “So it is a good time to update standards and definitions.” Harrell said the committee work thus far is leaning toward a definition that an “entity reserves report” should represent all or at least 80 percent of a company’s reserves, future production and/or revenues while identifying the relative importance of properties excluded from the report.

“An entity reserves report should reflect a significant, large part of the reserves base of the company,” he remarked. “On the other hand, a ‘property audit’ may involve only an individual well or reservoir or as much as several projects or fields.”

Harrell said that the phrase “reserves information” will refer to estimates and classifications of reserves, but could be finalized to also include production forecasts, future net revenues and the present values.

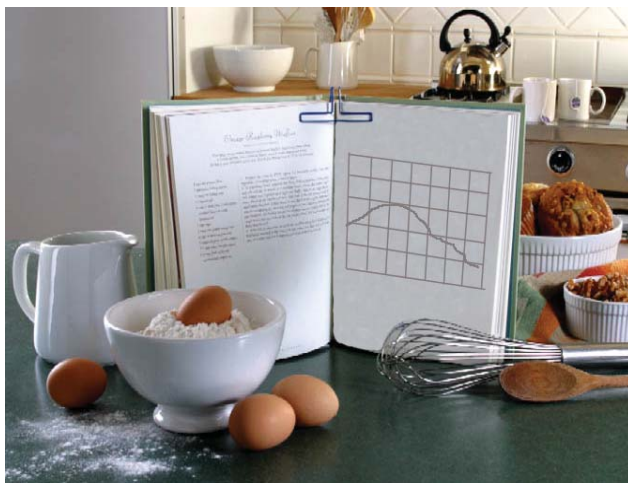
### Audits

The committee is researching elements of reserves audits in the areas of appropriateness of methods, adequacy and quality of data, depth and thoroughness of basic study, reserves classifications and the reasonableness of the estimated reserves information.

Harrell said SPE is considering defining reasonableness as plus or minus 10 percent agreement between the internal estimates and the audit. “As boards of directors get more involved in the process, they like estimates to be closer but may not always

understand the difficulty sometimes with certain categories of reserves,” he remarked. “Five percent tolerance is a tough, difficult goal and 10 percent can be tough in some instances.”

The industry co-opted the term “audit” from the accounting side causing confusion between financial and reserves audits. The SPE document will describe a financial audit and its distinctions to clear up misconceptions.



### Process reviews

Harrell said that the draft definition thus far of a process review is an assessment of the effectiveness of internal procedures, processes and controls relative to estimations of reserves. The process review is not considered sufficiently rigorous enough to validate reserves quantities or classifications.

### Qualifications

He remarked that the SPE committee put much effort in determining the qualifications of evaluators and auditors. Current qualifications for a reserves estimator are three years professional experience, one year reserves experience and appropriate degree or license. For a reserves auditor, they are 10 years experience, including five in responsible charge of reserves preparation, plus degree or license.

“Being a reserves auditor is a tough job because there are lots of rocks to look under and a qualified auditor knows where to look. Even though some of us have been doing this for a long time, we can all be fooled,” said Harrell.

The committee draft proposes that, in addition to those qualifications, estimators and auditors demonstrate knowledge of and take continuing education related to geological maps and models, proper usage of analogs, appropriate reliance on seismic, fundamentals of reservoir simulation, probabilistic methodologies, performance methodologies, understanding computer software, production sharing contracts/fiscal systems, relevant reserves definitions and ethics training.

“I don’t think that every evaluator needs to be an expert in simulation but I think evaluators need to be savvy enough to know where to look and to be suspicious of some of the output from black boxes,” Harrell remarked. “Evaluators need to have a basic understanding at least of what we can do with probabilistic methods and where they are applicable.”

### Overdue but necessary

Some of the additions to the document seem overdue and obvious, but they were necessary, said

*Please see Overdue on next page*



## CBM technical challenges explored at Ryder Scott reserves conference

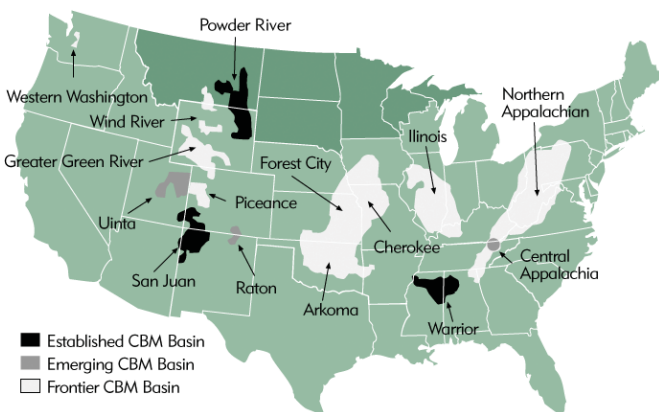
**Joe Blankenship**, senior vice president in charge of coalbed methane evaluations at Ryder Scott, presented his area of expertise at the Ryder Scott reserves conference in May, telling an audience of mostly engineers, "If you haven't looked at coalbed projects yet, you will," he said, as he showed that in 2004 CBM production climbed to nine percent of total natural gas production in the United States.

Blankenship began evaluating CBM projects about 17 years ago in the San Juan basin in Colorado and New Mexico. Over the past decade, he and others at Ryder Scott have evaluated more than 60 CBM areas.

In the United States, they performed extensive studies of numerous CBM fields and reservoirs in the Powder River, San Juan, Black Warrior, Raton, Arkoma, Appalachian and Uinta basins and in the Cherokee platform, Cahaba coal field and Alaska. Internationally, they have evaluated CBM reservoirs in China, Mexico, Australia, France, U.K., Poland, Colombia and elsewhere.

Blankenship showed Potential Gas Committee estimates of CBM resources in the U.S. by basin, with Powder River leading the pack at 26.7 Tcf, followed by the Northern Appalachian at 10.6 Tcf and the mature San Juan, third in resources at 10.2, but first in proved reserves with 8.5 Tcf, according to the U.S. Energy Information Administration for year-end 2002.

After covering basics, Blankenship focused on performance analysis, which when combined with



Participants on geology field trip see coal seam up close.

volumetric analysis and analogy to offset performance, comprises Ryder Scott's three-pronged approach to CBM subsurface evaluation. Showing production curves of CBM and water over time with both intersecting in a classic cross, he said, "This shows why a CBM well can be a reservoir engineer's nightmare in terms of being able to predict the future and is why volumetric calculations are so important."

Blankenship said that dewatering periods can last from a week to seven or eight years. The analogy method can narrow the predicted ranges at that stage and in estimating future production once the stable methane production climb begins.

The recovery of gas is nonlinear and not proportional to pressure because of the adsorption process, which is important to consider, said Blankenship. In the third stage of a CBM well's life, which Blankenship referred to as the "romance" stage, production declines. "The decline phase could be exponential or hyperbolic. Consider both and look for

*Please see CBM on next page*

### Overdue—Cont. from Page 6

Harrell. Among the more evident observations on practical applications of reserves classifications is that evaluators use 2P as the best estimate for many purposes.

Also, the committee is writing the draft document for geoscientists as well as engineers, acknowledging the integration of geoscience and engineering in reserves evaluations. This inclusion of a G&G point of view could have been in the standards in 2001 and perhaps even in the first 1977 standards.

### Other observations

■ On the 2P issue, Harrell said, "There is an in-

creasing interest in reporting beyond proved. Canada requires proved plus probable. The SEC is about the only one left that limits us to proved," Harrell remarked.

■ The draft document suggests that aggregation of reserves beyond the field or project level should be done by arithmetic summation by category. "We are trying to get away from some of the 'virtual reserves' that can occur with aggregation," said Harrell.

■ The document also discusses non-U.S. forms of ownership of reserves, including production-sharing and concession agreements.

■ Evaluators should be familiar with the regulatory definitions of an analog, especially those of the SEC which has a fairly narrow guideline, said Harrell.

**CBM—Cont. from Page 7**

guidance from nearby wells,” he said.

Blankenship said drilling fluids, completion techniques, back pressure and pump design, performance and maintenance affect CBM in a dramatic way. “If you reduce back pressure to 60 percent of original, in conventional reservoirs, you might get 40 percent of reserves. In coalbed, you might get a 10 percent recovery factor,” he said. “That is the bad part. You have to work hard to get the gas to produce and sell.”

Blankenship added that typically producers “get a lot of reserves in the last part of pressure reduction.”

On the plus side is the gas containing capacity of coal. A given volume of coal has a potential capacity to contain more gas than an equal volume of traditional hydrocarbon-bearing rock at the same depth and pressure, he said.

Blankenship showed calculations involving porosity, gas saturations, temperatures, pressures and compressibility factors for a conventional reservoir vs. calculations involving gas content, ash adjustment and density for a comparable CBM reservoir. The CBM reservoir had 42 percent more gas-in-place.

He illustrated that in CBM, the flow path for gas begins with diffusion through the coal matrix. Gas then feeds into a natural fracture system or cleat system. In frontier areas, producers test the fracture system early. Without a flow path, evaluation is difficult, said Blankenship, commenting that producers use horizontal drilling in areas, such as the Arkoma basin, where the fracture system is not as well developed, putting the coal matrix in closer proximity to the well bore.

Blankenship said that in the past, producers thought wells were undersaturated as they analyzed laboratory desorption data for gas content and reviewed adsorption isotherm curves, which plot storage capacity of the coals vs. pressure. Typically, they pulled cores, bled off gas, weighed the cores and estimated gas loss from cores not under pressure, but were not able to reliably measure the gas-loss compo-

ment.

“Empirically, gas desorption analysis alone has been found to understate the actual gas content even after the lost-gas correlation,” he said. Blankenship recommended the following:

- Assume the coal is saturated at the reservoir temperature and pressure until your information disproves this theory.
- Estimate the abandonment pressure based on the depth.
- Expect an estimated recovery factor between 50 percent and 85 percent.
- Adjust the isotherm for CO<sub>2</sub> content
- He also examined well evaluation techniques involving density logs for pay thickness, laboratory adsorption data for gas content, density data on pure coal and the ash, pressure gradient data, well spacing pattern and production data.

**Steve Phillips**, vice president and geologist at Ryder Scott, made a presentation on geological mapping of CBM reservoirs at the conference. A summary of his presentation will be published in September.

**James Latham**, vice president and petroleum engineer, demonstrated the rscCBM volumetric analysis freeware program, which is posted at [www.ryderscott.com](http://www.ryderscott.com). The slides from all three presentations are posted at the site under What’s New.

## Petroleum engineer joins Ryder Scott



Fitzgerald

**Jennifer A. Fitzgerald** joined Ryder Scott as a petroleum engineer from Exxon Mobil Corp. where she worked five years as a reservoir engineer. She was a reserves coordinator at Exxon and ensured compliance with internal controls and SEC regulations.

Fitzgerald has a BS degree in chemical engineering from the University of Illinois Champaign-Urbana and is a member of SPE.

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