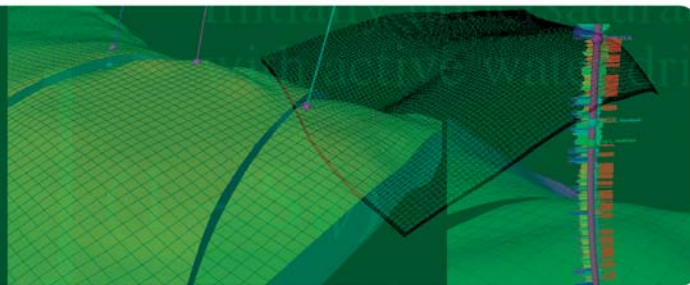


RESERVOIR SOLUTIONS



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Signals mixed for reporting of '09 unproved reserves

O&G companies analyzing processes and training staffs to disclose unproved reserves



Attendees at the Ryder Scott Reserves Conference in May heard Dr. John Lee say that smaller operators are interested in disclosing probable and possible reserves.

While most oil and gas companies are not rushing to report unproved petroleum reserves in '09 regulatory filings with the U.S. Securities and Exchange Commission, indications are that some early adopters are planning to disclose those optional categories. Several E&P companies are retooling internally to account for the reporting of their probable and possible reserves under the new SEC regulations, said CEO **Don Roesle** on Aug. 19 during a live Deloitte Web cast, "New SEC Disclosure Rules: Will You Need to Refine Your Reserve Reporting?"

Earlier indications were that few companies planned to disclose unproved oil and gas reserves at year end. The SEC rule allowing the reporting of probable and possible reserves was "tolerated" by some, said Dr. **John Lee**, a former SEC academic fellow, at the Ryder Scott Reserves Conference in May.

"Most large operators will probably not disclose reserves other than proved. Smaller operators appear to be much more interested in disclosing probable and possible reserves," he remarked.

When the SEC rules were proposed last year, several large E&P companies opposed not only mandatory, but optional reporting of unproved reserves. Those companies stated that if others in comparative peer groups chose to report unproved reserves, they would be pressured by investors and analysts to follow suit. They also said that filing less certain reserves categories with regulators would increase legal risks.

Proponents said that disclosing unproved reserves, specifically the 2P (proved plus probable) case, would benefit investors by showing the basis for business

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FASB aligns GAAP accounting with SEC average pricing for reserves disclosures



The U.S. Financial Accounting Standards Board decided to align GAAP disclosure and reserves-calculation requirements with the U.S. Securities and Exchange Commission's final rule on petroleum reserves disclosures. FASB planned to release a draft of the proposed accounting standards, which is subject to a 30-day comment period before finalizing.

Cash flows will be calculated using 12-month average prices for oil and gas instead of year-end prices. Also, a company is not required to present the effect of the adoption of new accounting standards within the roll forward of the proved reserve quantities.

FASB posted its Aug. 5 decision at www.fasb.org/oil_and_gas_disclosures.shtml#next_steps.

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Reserves to climb under SEC rules is conventional wisdom



Until the first quarter, it's anyone's guess as to whether significant volumes of proved reserves will be added to the books

because of more modern U.S. Securities and Exchange Commission disclosure rules. Early next year, analysts will comb through regulatory filings to look at reserves-based SMOG calculations, material changes in year-to-year proved undeveloped reserves and summaries of reliable oilfield technologies used to support estimates of additional reserves.

There are signs that reserves will increase. Ultra Petroleum Corp., which has tight-gas plays in southwestern Wyoming and properties in the Marcellus shale in the Northeast, said a third-party, mid-year update of proved reserves "using the more 'logical' 2009 SEC rules and 'unrestricted' by Ultra, resulted in an answer almost twice what... was reported at year-end 2008."

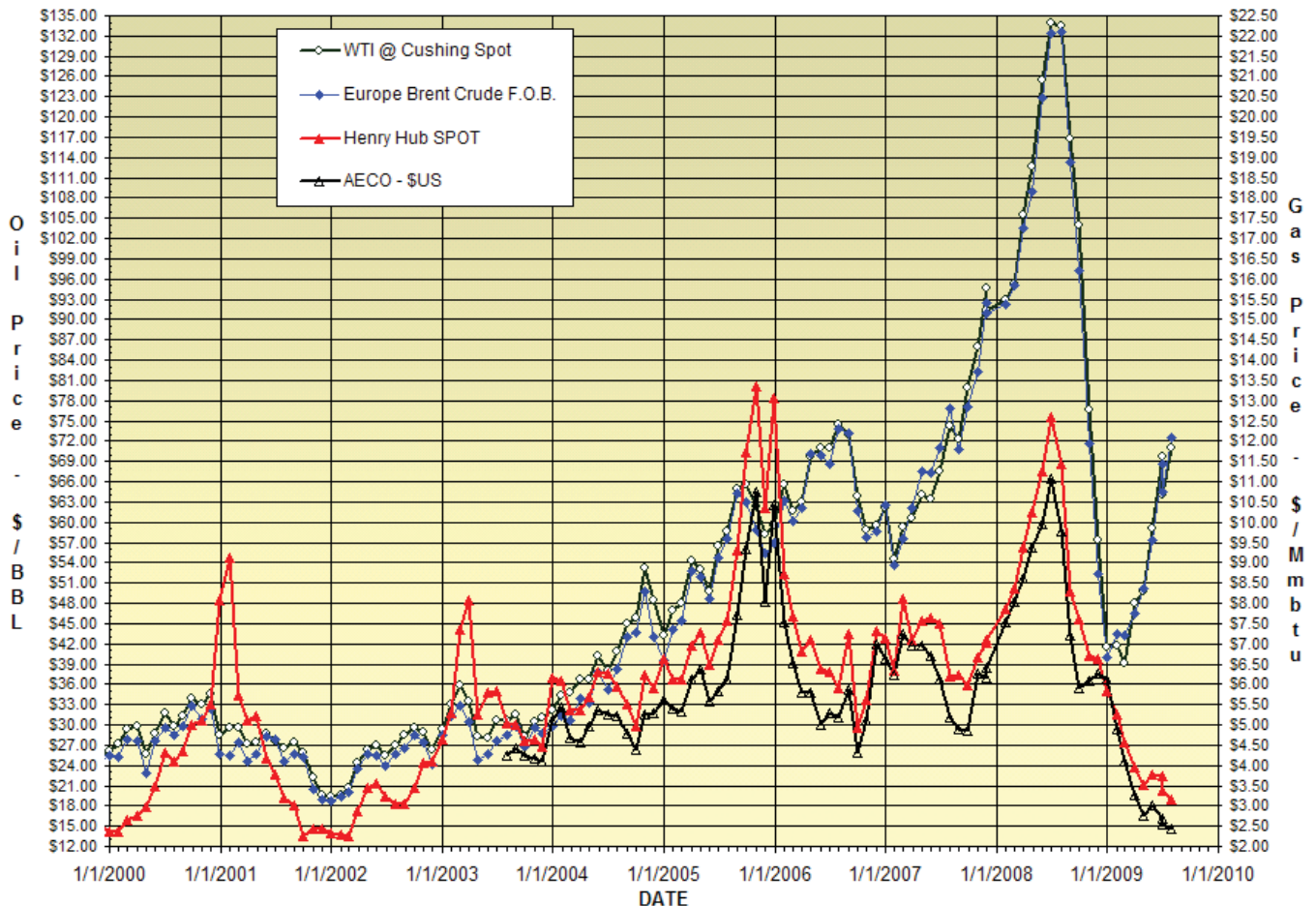
At the Ryder Scott Reserves Conference in May, Dr. **John Lee**, an academic fellow at the SEC during the rules-revision process, said that he expects to see "significant increases in disclosures of PUDs from locations beyond immediate offsets."

In an unscientific survey in July by a Society of Petroleum Engineers technical interest group, half of the respondents thought that their companies' reserves will increase less than 25 percent under new SEC rules with no one predicting reserves additions greater than that. Almost 40 percent saw no change at all.

Companies inevitably will build cases for booking additional reserves by citing new SEC rules on "reliable" technology. One major

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Price history of benchmark oil and gas in U.S. dollars



Published, monthly-average, cash market prices for WTI crude at Cushing (NYMEX), Brent crude and Henry Hub and AECO gas.

Auditing Tolerances: How close is close enough?

The petroleum reserves sector is looking for reasonable audit tolerances to be established now that U.S. Securities and Exchange Commission rules for year-end 2009 allow companies to file unproved reserves. Industry has not standardized those tolerances for unproved categories.

That is not the case for proved. To pass a petroleum reserves audit, total proved reserves estimates cannot vary more than 10 percent from those of the outside auditor. That tolerance level was “blessed” by the Society of Petroleum Engineers two years ago in its “Standards Pertaining to the Estimating and Auditing of Oil and Gas Reserves Information.”

Ron Harrell, chairman emeritus at Ryder Scott, was a principal contributor to the SPE audit guidelines. “Before the 2007 standards, the ‘reasonableness’ term was applied on a case-by-case basis but often was never quantified,” he said.

SEC-SPE connection and tolerances

Traditionally, SPE refrains from lobbying, political activity or any other pursuits outside its core mission. The professional society considers that relationships with regulatory bodies are appropriate when based on the exchange of technical knowledge. The SPE reserves committee established worldwide reserves standards in 2007 that are suitable for regulatory and reporting bodies.

Historically, the SPE-SEC connection began in the early 1970s. The Arab oil embargo and long gas lines in the United States created a groundswell for Congressional action resulting in the creation of various federal agencies and passage of oil and gas legislation during that decade. In 1978, the SEC ruled that publicly owned oil and gas producers annually report proved reserves.

Influenced by those events, SPE released its generally accepted set of audit guidelines in 1977. They underwent minor revisions in 2001 and major ones in 2007.

Over that time, the SEC never officially endorsed SPE audit principles. However, because the agency has not drafted audit standards of its own, it defers to industry best practices, which de-facto are SPE principles.

The SEC has not drafted audit standards, because it has never mandated that public issuers use independent reserves auditors. An issuer is only required to file a reserves audit summary letter if it represents that a third party audited company estimates. While the SEC requires that 10 items be included in the audit summary, the Commission does not specify tolerance percentages.

New SEC rules reference the 2007 Petroleum Resources Management System more than 30 times while stating that “many of the (SEC) definitions are designed to be consistent with the SPE-PRMS.” However, the SEC does not refer to SPE auditing guidelines by name. The Commission rather cites its own definition of a reserves audit, which is word-for-word identical to the SPE definition.

The SEC routinely accepts proved reserves quantities estimated under its definitions and audited using SPE principles.

One of the items to be filed in the new audit summary report is “a brief summary of the third party’s conclusions with respect to the reserves estimates.” Without specifying the exact tolerance, those audit conclusions may include an attestation from the consultant that the company’s reserves estimates fall within a 10 percent tolerance guideline as set forth in SPE audit standards.

Occasionally, the SEC requests through comment letters that a

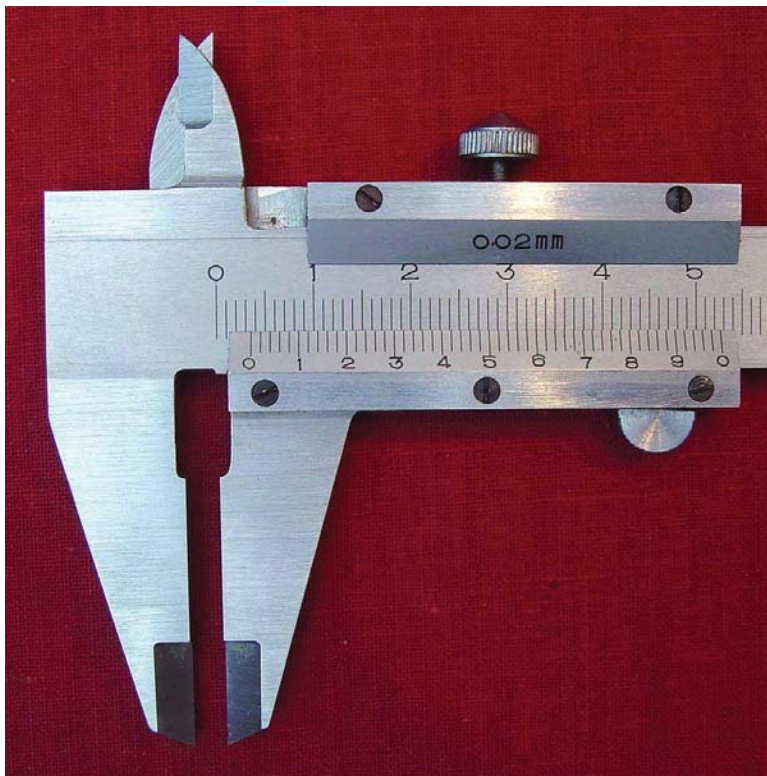
public issuer disclose specific tolerances from the full audit report letter, which is not required to be filed. Some companies have spurned that request while others have complied.

How close is close enough?

Now that the SEC allows the optional reporting of probable and possible reserves, companies may want those categories audited by an outside consultant for regulatory reporting compliance. However, the use of the SPE 10-percent tolerance doesn’t apply to unproved reserves.

“The standards do not recommend specific tolerances for audits of probable and possible reserves,” said Harrell. “The imposition of a ten percent tolerance to

Please see Harrell on Page 7



Undeveloped locations: How far and how many?

At the Ryder Scott Reserves Conference, **Bob Wagner**, former senior vice president at Ryder Scott, presented the ramifications of recent SEC rules changes on booking oil and gas reserves in undeveloped field locations. Previous SEC regulations imposed a one-offset rule for proved undeveloped locations unless certainty could be demonstrated at greater distances. Recently adopted changes potentially allow more locations at greater distances from well bores.

So, how far is too far and how many are too many? Wagner described several key considerations, including reasonable certainty, reservoir continuity and economic producibility. The revision of the term “certainty” to “reasonable certainty” for areas beyond one offset is the most significant of the SEC changes for booking proved reserves in undeveloped locations, said Wagner. The SEC states that reasonable certainty means a high degree of confidence and that the quantity is much more likely to be achieved than not. In probabilistic terms for proved reserves, reasonable certainty is a P90 case.

Wagner stated that undrilled portions of a reservoir must be demonstrated to be continuous with existing production to book undeveloped reserves. Supporting evidence may include log data from multiple wells and correlative production intervals, pressure measurements, partial depletion in an undrilled area, movement of fluid contacts in new wells and consistency in fluid and reservoir parameters.

In booking undeveloped reserves, Wagner suggested several “reservoir yardsticks” to demonstrate economic producibility, including permeability, thickness, hydrocarbon content and analogies. Management also has to endorse a development plan and offer compelling evidence that the company has the commitment and financial means to carry out the plan.

Also, under the new regulations, the SEC will allow the use of reliable technology to help demonstrate reasonable certainty of reservoir continuity and economic producibility. That may include RFTs to determine productive intervals and seismic data combined with pressure-gradient analysis to determine fluid contacts. Wagner said that establishing and documenting a clear track record will be important for a company to demonstrate that the technology in question is reliable enough to show reasonable certainty in a specific geographical area.

Wagner also pointed out that reservoir continuity and economic producibility must be demonstrated with reasonable certainty and documented for every location for all undeveloped categories, not just proved ones. Furthermore, SEC regulations now specifically prohibit booking “adjacent reservoirs isolated by major, potentially sealing, faults” until penetrated and shown to be commercial. Also ruled out are “areas that are clearly separated from a known accumulation by a non-productive reservoir”, which could include offsets to dry holes, reservoirs separated by discontinuous seismic amplitudes and areas with inconsistent reservoir parameters or log correlations.

“That may cause some dismay and a downgrade of



Wagner at fifth annual reserves conference.

reserves to prospective resources for companies that have historically assigned probable and possible locations in such situations,” said Wagner.

Once an area is shown to satisfy the necessary criteria to be called reserves, what then determines the category? Wagner stated that data quantity and quality are key and that the overall “degree of certainty associated with the totality of the data will determine whether any reserves may be assigned to a location and what category is most appropriate.”

He said that “when it comes to the bottom line, there is no cookbook answer to booking undeveloped locations and assigning a category of proved, probable or possible. The specific data, on a case-by-case evaluation, will determine how far and how many.” In addition, Wagner stressed that “the burden of proof rests with the evaluator” and that the supporting documentation must be “ready to go.”

Editor's Note: The expressed opinions in this article and others herein are not necessarily those of the SEC. Consider the applicability of such opinions on a case basis. Ryder Scott's current analysis of the SEC regulations is subject to change as the agency gives additional clarification through public announcements, staff notices, comment letters, etc. For greater detail on this topic and on the complete conference proceedings, visit www.ryderscott.com/presentations.

Average prices: How hard can it be to get that right?

Pricing for calculating petroleum reserves under new U.S. Securities and Exchange Commission rules was the presentation topic of **Fred W. Ziehe**, managing senior vice president at Ryder Scott, at the firm's reserves conference earlier this year. Since that presentation, the U.S. Financial Accounting Standards Board has moved to align accounting standards with the new pricing rules for disclosing reserves. See article on Page 1.

Under FASB 69, public issuers will use an average price rather than single-day, end-of-period price. The SEC rule states that the existing economic conditions for determining economic producibility shall include the "12-month average price, calculated as the unweighted arithmetic average of the first-day-of-the-month price for each month within the 12-month period prior to the reporting period."

Oil prices are not published on holidays and weekends. If the first of the month falls on a holiday or weekend day, the posted price of the preceding day or latest day for which a published market price is available is in effect. The same logic applies for oil spot cash market prices.

Determination of gas prices differs from oil. Gas is priced one day in advance on the spot market. The price determined on the transaction date (12/31) sets the price for gas sold on the flow date (1/1). Table below illustrates pricing in effect for the beginning of this year:

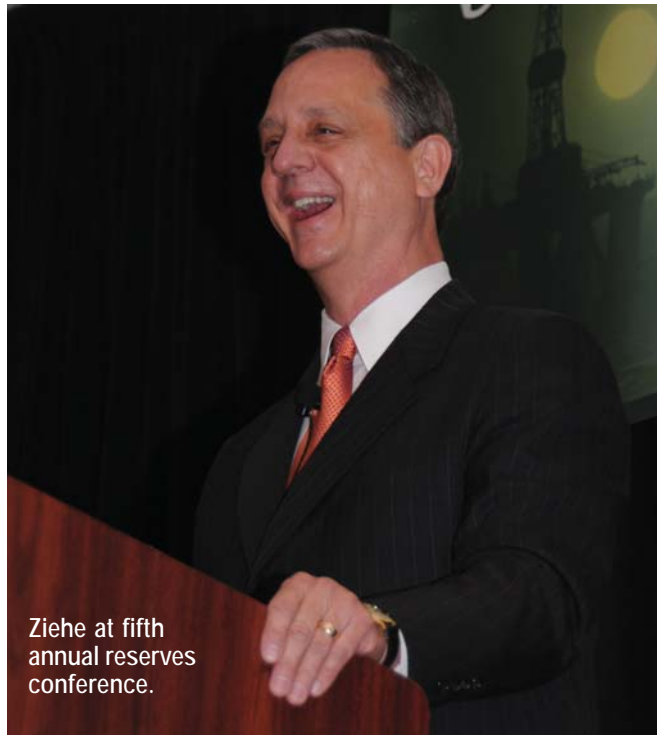
Transaction Date	Flow Date	Henry Hub Price \$/MMBtu
Tues 12/30/2008	Wed 12/31/2008	\$5.71
Wed 12/31/2008	Thurs 1/1/2009	\$5.61
Thurs 1/1/2009	Fri 1/2/2009	\$5.61
Thurs 1/29/2009	Fri 1/30/2009	\$4.70
Fri 1/30/2009	Sat 1/31/2009	\$4.70
Sat 1/31/2009	Sun 2/1/2009	\$4.77
Sun 2/1/2009	Mon 2/2/2009	\$4.77

That process continues through holidays or weekends, so there are no missing prices during those times. The caveat for gas prices is that the ending price of one month cannot be the same price as the beginning price in another month.

It is extremely important that differentials be applied to these benchmark prices based on consistent methods of comparing actual sales prices to the appropriate benchmarks. It is not appropriate to apply the differential of sales prices and posted prices to benchmark spot prices or vice versa.

Access first-day-of-the-month prices as follows:

- Ryder Scott Web site, www.ryderscott.com, under the What's New tab—Presents a table with first-day-of-the-month prices.
- Call a Ryder Scott engineer.
- For WTI Cushing cash market oil prices, go to the following EIA Web site at <http://www.eia.doe.gov/emeu/>



Ziehe at fifth annual reserves conference.

international/prices.html#Crude. The source for those prices is stated to be from the *Wall Street Journal*.

■ For Brent prices, another EIA Web site quotes prices from Reuters at <http://www.eia.doe.gov/emeu/international/oilprice.html>. Prices are under "F.O.B. (Free on Board) Spot Price of Brent Crude Oil in Europe."

■ A public source for gas spot prices is <http://intelligencepress.com/features/intctx/gas/>.

For further information, send an e-mail request to Ziehe at fred_ziehe@ryderscott.com. His conference presentation and others are posted at ryderscott.com.

Rietz to present 2-day simulation course at SPE-ATCE on Oct. 3-4

Dean Rietz, managing senior vice president and group leader for the reservoir simulation group, is a co-instructor at the two-day short course, "Reservoir Simulation for Practical Decision Making," at the Society of Petroleum Engineers annual meeting in New Orleans. He and co-instructor **Miles Palke** will discuss all of the important facets of the reservoir modeling process on Saturday, Oct. 3, and Sunday, Oct. 4, from 8 a.m. to 5 p.m. both days at the convention.

Specific topics include data acquisition, fluid properties, rock-fluid interaction, grid construction, history matching, and prediction cases. Those interested in attending can get further information by contacting conference management via e-mail at atce@experient-inc.com or phone 301-694-5243.

Hein presents tight-gas evaluation methods, insights



Hein

Author's Notes: This article is a synopsis of a short course presented at the annual meeting of the Society of Petroleum Evaluation Engineers in Santa Fe, NM, on June 14. The course, "Evaluation of Tight Gas Reservoirs," was developed to provide the state of the art in tight-gas evaluations and included a compilation of the most relevant methods from industry and insights from professional experience.

Victor Hein is a University of Tulsa graduate

in petroleum engineering with 36 years experience in the oil and gas industry and has been evaluating tight-gas reservoirs since 1979. For more information, contact him at victor_hein@ryderscott.com.

Tight gas has been an important resource since the 1970s when massive hydraulic fracturing made previously marginal plays economic. Tight gas continues to be extremely important in the U.S., where it represents 20 percent of gas production, and internationally. The percentage of U.S gas production coming from unconventional gas is expected to increase from 44 percent in 2005 to 49 percent by 2030. Using horizontal drilling, large-scale hydraulic fracturing and emerging technology, tight gas could supply more than one-third of total U.S consumption, currently estimated at 22 Tcf a year, within decades.

Volumetric calculations for tight-gas reservoirs traditionally have been extremely difficult to perform primarily because of the interdependence of two parameters: effective drainage area and recovery factor. However, if one of those variables is defined or estimated from simulation or other methods, volumetric calculations are still very useful.

Formation evaluation of tight-gas reservoirs is difficult because of the presence of shale, pore geometry and other factors. Water saturations are often overestimated because of cation exchange capacity and insufficient data in the derivation of some of the original shale models. When calculating water saturations, keep in mind that the cementation exponent (m) can be lower than values traditionally used in low-permeability rocks, as shown in a recent U.S. Department of Energy study focusing on the Mesaverde formation in Colorado, Utah and Wyoming.

The addition of nuclear magnetic resonance imaging logs can substantially aid in log analysis. Additionally, the evaluator should use rock typing and proper procedures for measuring or estimating permeability in rocks with smaller pore throats.

Traditional material-balance calculations in tight-gas reservoirs have been difficult to interpret because of the long time to pseudo radial flow caused by low

permeability and large effective wellbore area.

There are several options to facilitate acquisition, enhance analysis of pressure data and minimize pitfalls in common static material-balance analysis. The flowing material balance introduced by Matter is a method for circumventing some problems inherent in the static material balance.

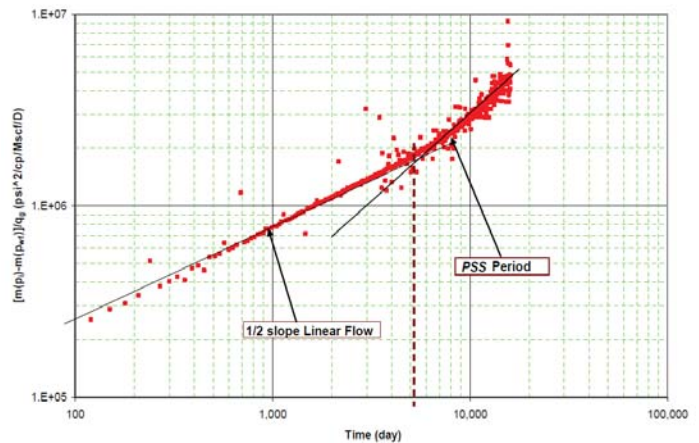
Evaluators frequently use conventional decline-curve analysis, introduced by Arps in 1945, to assess tight-gas reserves. However, Arps' original work was empirically developed and only valid in boundary-dominated flow. Accordingly, there is considerable misuse of "b" hyperbolic exponents within the industry.

In the vast majority of cases, b exponents greater than 1 are the result of either transient flow or incorrect interpretation. The final segment of a decline-curve projection should have a b factor less than 1. Simulation models show a direct correlation in error with higher b factors above 1 (Rushing, et al). Errors can be as high as 150 percent.

Methods proposed by Cheng, Lee and McVay are helpful in estimating b factors and reduce potential error when dealing with wells in transient flow with high apparent b factors. Work done by Rushing, Perego and Blasingame is helpful in decline-curve analysis for coal-bed methane reservoirs.

Empirical observations and work done by Vera have tested assumptions and pointed out the benefits and pitfalls of production-history-matching programs for obtaining reservoir properties and occasionally drainage area.

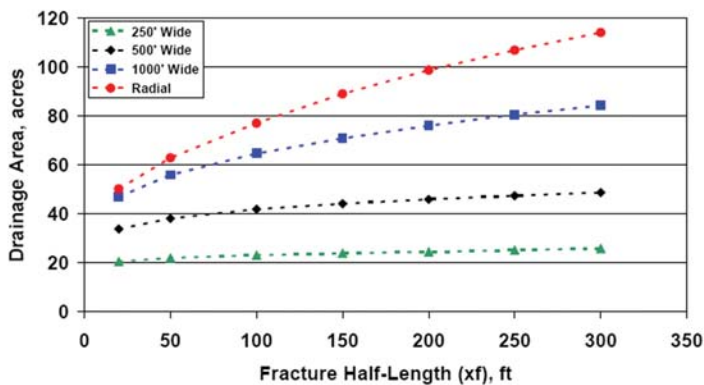
The various flow regimes encountered in fractured gas wells, starting with fracture linear flow and progressing through pseudo-radial flow, were described by Cinco, et al. Cinco, Lee, Badazhkov and their respective colleagues have helped explain duration of flow periods, characteristics and use or limitations of data from each period.



Linear flow is quite common in tight-gas analysis. Ibrahim and Wattenbarger originated formulas to calculate the square root of permeability times cross sectional area to flow and original gas in place using production data. See graph above. Correction factors adjust solutions for the magnitude of drawdown.

Advanced production analysis involves methods originating with Fetkovich and progressing to those of Blasingame, Agarwal and others. Advanced production analysis allows for a more rigorous evaluation of production data by incorporating flowing pressures, type curves for various models and diagnostics relative to flow period, i.e., transient vs. boundary-dominated flow.

Impact of Fracture Half-Length on Effective Drainage Area, $k = 0.1$ md



Cox et al performed simulation studies relating the effects of half-frac length and permeability to drainage area, including the practical limits of half-frac lengths for linear geometries, such as channel sands.

Olds presents “cowboy” ethics



Olds at fifth annual reserves conference.

The role of ethics in the face of changing industry guidelines was presented by **Dan Olds**, senior vice president, at the Ryder Scott Reserves Conference earlier this year. He discussed principles of acceptable evaluation engineering practices from an SPEE ethics monograph as well as citations from “Cowboy Ethics: What Wall Street Can Learn from the Code of the West,” a book by James P. Owen.

Olds discussed roles of evaluation engineers and

Harrell—Cont. from Page 3

these categories may be too limiting given the wide range of uncertainty associated with unproved reserves.”

Others believe that technical uncertainty range and audit tolerance are independent variables. They argue that if companies and their reserves auditors use all reasonable due diligence to estimate unproved reserves, then uncertainty ranges in those categories shouldn’t cause significant variances between auditor and audited.

Harrell concluded, “Industry has insufficient experience with auditing unproved reserves thus far to warrant the establishment of appropriate tolerances.”

While increasing the upper limit for audit tolerances can be argued, Harrell and others, for the most part, agree that it should not be lowered. “Increasing board involvement in corporate reserves estimation processes and internal and external audit results has led to well-meaning suggestions to reduce the acceptable tolerance for proved reserves to five percent,” said Harrell. “In most cases, the perceived improved confidence ascribed to this lowered tolerance will not offset the time and costs to achieve that end.”

Ultimately, tolerance levels may not be as important as reasonableness as determined by a qualified auditor. A reserves auditor is usually a licensed, degreed petroleum engineer with at least 10 years of professional experience, including at least five years in estimating reserves.

Harrell will present audit tolerances and other issues from SPE Paper No. 124260, “The Growing Importance of Petroleum Reserves Estimating and Auditing Standards,” at the SPE annual meeting in New Orleans on Wednesday, Oct. 7 at 9:45 a.m. in Room 217/218 at the Ernest N. Morial Convention Center.

responsibilities to the public and within their own organizations as set out in the monogram, “Discussion and Guidance on Ethics.” He highlighted the importance of staying within one’s area of expertise in both internal and external dealings.

Olds stressed the responsibility of evaluation engineers to clearly and fully disclose reserves definitions while mentioning Ryder Scott’s effort in interpreting new U.S. SEC regulations and sharing those opinions. “There have been many hours that Ryder Scott has spent preparing these conference presentations... It’s been a very consensus-building process to arrive at the proper interpretation of the new regulations and to come up with the presentations that you have seen here today,” he remarked.

In discussing Owen’s book on ethics, Olds said the author personifies the cowboy as someone who always does the right thing, contrary to the stereotypical shoot-from-the-hip persona. He also analyzed several recent, real-world examples of scandals in which the accused had rationalized their actions, including a brouhaha involving U.S. Senator Ted Stevens, who was accused of failing to report gifts in violation of the Ethics in Government Act.

The presentation is posted at www.ryderscott.com/presentations.

Unproved—Cont. from Page 1

decisions and by providing a clearer financial picture. Although companies already cite unproved reserves in press releases and management discussion, the potential for disclosing them in regulatory filings has sparked an effort to improve the level of rigor applied to those estimates.

"Companies are modifying their internal reserves processes to handle non-proved reserves. They are also training their staffs," remarked Roesle, adding that registrants are to file proved and unproved reserves separately, not their 2P reserves.

More than 1,000 Web cast "viewers" saw the live online presentation by Roesle as well as presentations by **Jed Shreve**, principal at Deloitte Financial Advisory Services LLP, and **Phillip Hilsher**, partner at Deloitte & Touche LLP.

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In a poll during the Web cast, slightly more than 12 percent of the audience indicated that their companies planned to disclose probable and possible reserves while more than 7 percent indicated no plans. (A large audience segment was not from the oil and gas production sector reflected in the six of 10 who said that the question wasn't applicable or they did not know of their companies' plans.)

Most tellingly, more than 20 percent selected an answer, "maybe, if peer companies disclose probable and possible reserves," indicating a "herd mentality."

In its "SEC Modernization Survey," a Society of Petroleum Engineers technical interest group reported in July that 38 percent of respondents planned to file probable and possible reserves while half did not. A sample size of 16 responded, so survey results are not statistically significant.

Deloitte's Dbriefs Web cast with Roesle can be accessed through the Events link at www.deloitte.com/

Reserves Adds—Cont. from Page 2

issue will be assigning proved reserves to an unpenetrated reservoir based on similarities between a seismic response in that reservoir and in an adjacent drilled reservoir.

The SEC prohibits assigning reserves to a reservoir isolated by a potentially sealing fault, even if subject reservoir is adjacent to a known accumulation. In circumstances, for instance, where a

company has a documented history that drilling seismic bright spots has a 90 percent success rate in a "statistical" play, then the producer may build a technology case for assigning reserves to undeveloped stepout locations, even if they are fault separated from the producing reservoir.

That could be a major point of contention between public issuer and public watchdog as well as a "tough sell." The SEC has taken a rules-based approach on that issue in the past. Oil and gas companies are hoping for published clarifications on issues such as that, but traditionally, the SEC has handled matters on a case basis through the comment-letter process.

Perhaps adding to any potential confusion, the SEC is not aligned with the Society of Petroleum Engineers Petroleum Resources Management System on the issue. SPE stops short of an absolute rule against assigning reserves to a fault-separated, adjacent reservoir but rather advises caution and clear documentation to support such a reserves assignment.

Publisher's Statement

Reservoir Solutions newsletter is published quarterly by Ryder Scott Co. 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 115 employees, including 81 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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