

# RESERVOIR SOLUTIONS



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## Ryder Scott to assist Russia in its effort to develop reserves reporting system with international standards

The National Association for Subsoil Examination (NP NAEN) in Russia and Ryder Scott jointly agreed to work together to assist the country in its efforts to establish a new classification system of oil and gas reserves and resources to become effective as early as Jan. 1, 2016. The new guidelines will take into account definitions, classifications, best practices and experience in applying US and Canadian regulatory systems over as long as 10 years. NP NAEN and Ryder Scott will also examine the Society of Petroleum Engineers Petroleum Resources Management System, which has become the de-facto international standard for technical reserves evaluations and which is accepted by numerous regulatory regimes.

NP NAEN is a non-profit organization of subsoil users (petroleum and mineral E&P sectors), industrial enterprises and expert organizations that study petroleum and mineral extraction and processing. NP NAEN aims to increase transparency and materiality in public reporting to help

investors understand information and to provide guidance. Increased materiality will help to ensure that reports are complete and include all information that the users of that material require.

**Larry Connor**, managing senior vice president, and **Shakbulat Giravov**, an NP NAEN director and first deputy general director of the GKZ, signed a memorandum of

understanding (MOU) on March 7. The GKZ, which is the FGU State Commission on Mineral Reserves, is a regulatory agency that sets and oversees requirements for reserves reporting in Russia.

OERN, an organization of subsurface experts who develop the Russian code for mineral and petroleum reserves reporting,

*Please see MOU on Page 3*



Larry Connor (left), managing senior vice president, and Shakbulat Giravov, an NP NAEN director and first deputy general director at the GKZ, signed a memorandum of understanding (MOU) on March 7 at Ryder Scott's Houston office.

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## NP NAEN, RS to co-host training session in Moscow

The National Association for Subsoil Examination (NP NAEN) in Russia and Ryder Scott Petroleum Consultants will jointly present a training session on international petroleum reserves standards to NP NAEN members and colleagues on Wednesday, Oct. 29 at the Ritz Carlton Moscow hotel. NP NAEN is a non-profit organization of subsoil users (petroleum and mineral E&P sectors), industrial enterprises and expert organizations that study petroleum and mineral extraction and processing. The organization aims to increase transparency and materiality in public reporting. See article on memorandum of understanding between NP NAEN and Ryder Scott on Page 1.

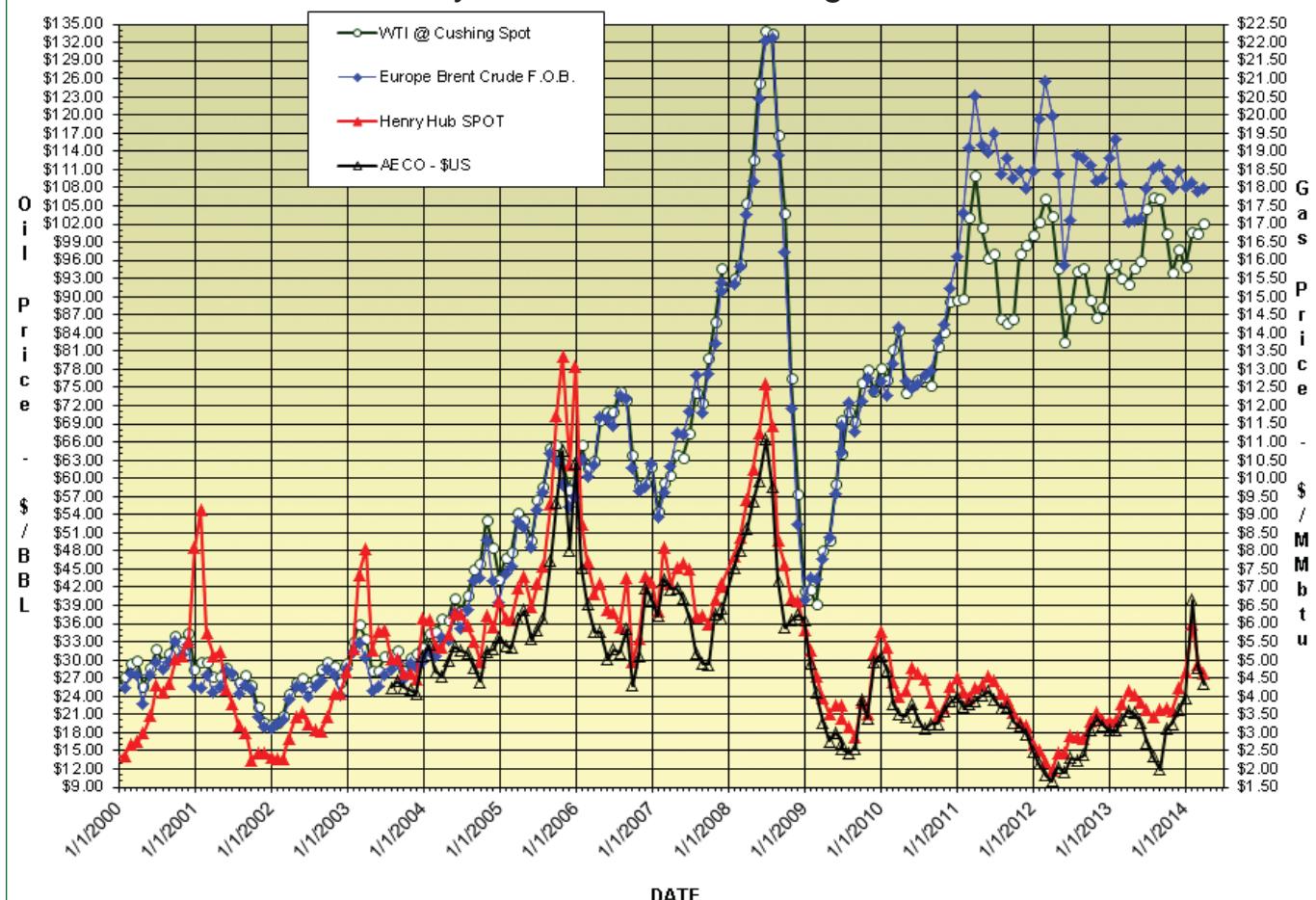
NP NAEN anticipates about 200 participants will attend the two-day session. On the second day, Thursday, Oct. 30, the conference will focus on mineral reserves.

The agenda is aimed at financial, government, legal and technical professionals in petroleum and minerals reserves. The event is supported by the FGU State Commission on Mineral Reserves (GKZ) and the Federal Subsoil Resources Management Agency

*Please see Training Session on Page 3*



### 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.

**MOU—Cont. from Page 1**

assists the GKZ. NP NAEN, a self-regulating organization of corporate members and OERN representatives, coordinates and financially supports OERN.

The former Soviet system for classification of reserves and resources, developed in 1960 and revised in 1981, is still used today in Russia and by some FSU countries. Nine years ago, the Ministry of Natural Resources and Environment developed the RF-2005 Russian Federation classification scheme, a planned first step to bring the old Soviet system in line with more modern standards. However more delays followed and now the government considers the RF-2005 guidelines to be outdated.

The MOU calls for NP NAEN and Ryder Scott to jointly review resources and reserves disclosures in public reports under international reserves classification systems. Public reports are annual and quarterly company reports, press releases, technical papers, website postings, public presentations and other published material.

NP NAEN and Ryder Scott will review proposals on the development of the planned 2016 oil and gas reserves and resources definition-and-classification system and analyze the implications. Ryder Scott will

**Training Session—Cont. from Page 2**

(ROSNEDRA). Representatives from NP NAEN, GKZ, ROSNEDRA, Ryder Scott and Moscow-based FDP Engineering LLP, a long-time alliance partner of Ryder Scott, are on the organizing committee.

The agenda for Oct. 29 will be as follows:

- 9:30-10 a.m. -- Registration of attendees
- 10-10:35 a.m. -- Opening presentations on cooperation of Ryder Scott and NP NAEN from representatives of the two organizations and FDP
- 10:40-11:20 a.m. -- Current legal issues of importance in Russia from Moscow law firm
- 11:25 a.m.-noon -- Oil shale evaluation and experiences worldwide from Ryder Scott
- 12:05-12:55 p.m. -- Proper methodology to evaluate prospective resources from Ryder Scott and GKZ
- 12:55-1:55 p.m. -- Lunch
- 1:55-2:30 p.m. -- Comparison of SPE-PRMS and other worldwide reserves definition systems from Ryder Scott
- 2:35-3:20 p.m. -- Latest version of the new Russian reserves classification system from the GKZ
- 3:25-4:10 p.m. -- Panel discussion on the contents of an effective reserve report from financial, engineering, geological and GKZ representatives
- 4:10-4:35 p.m. -- Break with snacks and beverages
- 4:35-5:15 p.m. -- Effective use of and role of simulation in reserve reporting from Ryder Scott
- 5:20-6 p.m. -- Role of National Association for Subsoil Use in auditing from NP NAEN
- 6 p.m. -- Reception

Presentations will be in Russian and English and interpreters will be on hand. For attendees, admission to the Oct. 29 event will be \$1,390 USD with a 25 percent discount if registering before Aug. 1. The discount will be 15 percent for those registering between Aug. 2 and Sept. 1. Those companies registering three to four attendees will get a 20-percent discount

prepare methodological recommendations based on its experience using SPE-PRMS guidelines and preparing reserves reports that comply with the regulatory rules of the U.S. Securities and Exchange Commission and Canada's National Instrument 51-101.

Under the MOU, Ryder Scott will also conduct independent hydrocarbon reserves and resources evaluations in accordance with the SPE-PRMS and the U.S. and Canadian systems. The firm will also conduct training sessions on various reserves classification systems. Please see article on the NP NAEN-Ryder Scott reserves session to be held in Moscow on Wednesday, October 29.

The joint projects will not interfere with any corporate articles of incorporation or with activities allowed by national legislation in the countries where those companies are based. For companies participating in the program, Ryder Scott has also agreed to extend competitive pricing and expeditious turnaround times to prepare independent reports acknowledged worldwide for their reliability.

"That creates a unique opportunity for subsoil users to undergo the state examination of mineral reserves and an international audit for private purposes at the same time," said Giravov.

and five or more is a 25-percent discount.

For more information, please contact **Daria Fedtsova** at fedtsova.naen@mail.ru or **Natalia Shikun** at shikun@naen.ru.



Pump jacks in west Siberia lift crude. New Russian Federation petroleum reserves standards are planned for as early as 2016.

# SEC comments surge; expiring acreage, volume definitions are new topics, shows Ryder Scott survey

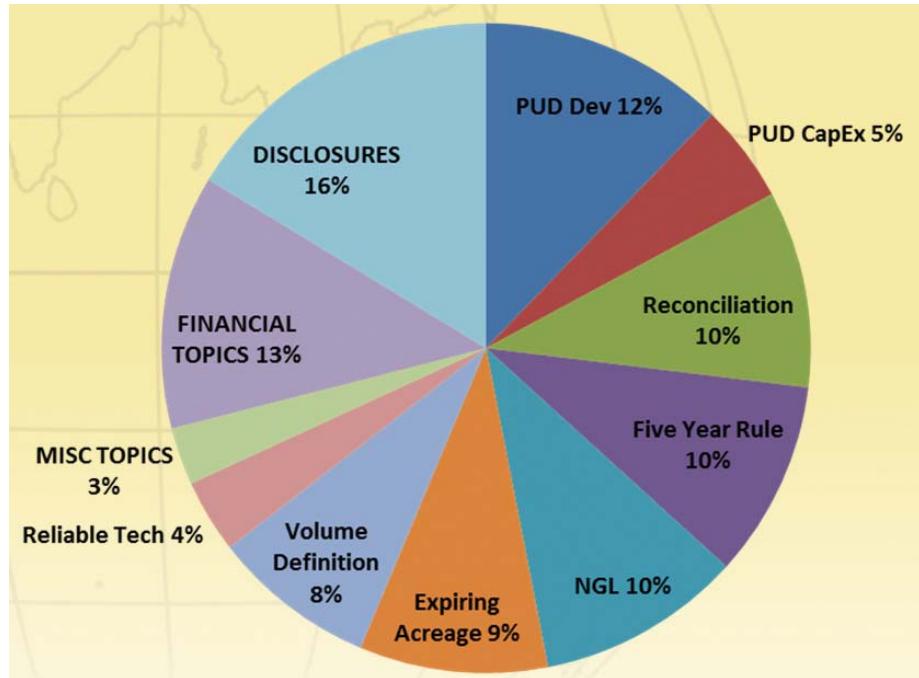
U.S. regulators have a new focus area on petroleum reserves filings, said **Jeffrey Wilson**, managing senior vice president. They now question what portion of soon-to-be expiring undeveloped acreage was filed as proved undeveloped reserves. For instance, in its year-end 2012 filing, Cabot Oil & Gas Co. disclosed undeveloped acreage scheduled to expire in 2013, 2014 and 2015 but did not disclose what portion was proved. The SEC requested the associated proved volumes be quantified. Additionally, the SEC asked if any of the PUD locations set to expire would be drilled to hold the lease and develop it under a management-adopted development plan. In total, 23 companies received similar questions.

The SEC also has renewed its emphasis on volume definitions, for instance, stating that the use of ambiguous reserves references, such as "potential reserves," is not permitted. The agency wants more granularity to accompany reported downward revisions. Examples include a company that classified volumes as proved developed non-producing before an \$18-million compression system was installed.

The SEC asked why the volumes were not reported as PUDs. Another company "reclassified (an offshore platform) to unproved properties," and was asked, "Explain to us, in reasonable detail, your basis for this accounting. As part of your response, provide reference to the specific accounting literature that supports the reclassification."

The questions on volume definitions are insightful. Wilson said, "This demonstrates a transition from early fact checking, after the SEC's "modernized" regulations went into effect, to more closely scrutinizing reserve bookings, and often referencing disclosures made in earlier filings," said Wilson. The agency's "Final Rule: Modernization of Oil and Gas Reporting," which went into effect for year-end 2009 filings, has been in place for five annual reporting periods.

"The SEC often references multiple filing periods and asks



## Topics of SEC comments on YE 2012 filings

companies to account for bookings that can span several years," said Wilson. "Numerous companies with downward revisions over several filing periods were asked to expand on their interpretations of 'reasonable certainty.'"

Wilson surveyed the 2013 comment letters through the Ryder Scott web-based SEC Seeker utility that does custom searches through the SEC's Edgar database.

Agency scrutiny is increasing. SEC comment letters soared from 77 addressing YE-2012 filings to 211 for YE 2013. Reserves-related comments surged from 78 to 245. Development of proved undeveloped reserves continues to be the No. 1 issue, comprising 27 percent of the comments.

PUD development, associated capital expenses to convert PUDs to other reserves categories and the five-year limit for conversion are the main issues with the SEC, said Wilson.

The second most frequent comment was aimed at companies not reporting natural gas liquid reserves separately from oil and gas

reserves. "The staff considers NGLs to be a separate product type," the SEC said.

The third-most cited issue involved reconciliation of material changes to PUDs. One company with significant changes reported PUDs converted to developed categories and added as extensions and discoveries. However, the public issuer did not disclose any further revisions to fully account for overall PUD conversions, including, for instance, changes caused by acquisitions and divestitures or improved recovery programs.

The modernized rules allow companies to book PUD locations based on the use of "reliable" technology, which, by definition has been field tested and demonstrated to provide reasonably certain results with consistency and repeatability in evaluated or analogous formations. Rex Energy Corp. booked 33 PUD locations based on reliable technology and the SEC commented that if this

*Please see Comment Letters on Page 8*

## Two senior petroleum engineers join Ryder Scott



Filler

**Stuart L. Filler** has joined Ryder Scott as a senior petroleum engineer. "Stuart is widely considered to be an industry expert in reserves classifications and definitions under various systems," said Fred Ziehe, managing senior vice president. Filler was a member of the SPE-PRMS Applications Document Subcommittee and a chapter reviewer for the Guidelines for Application of the Petroleum Resources

Management System published in 2011. Also, he was a member of both the Society of Petroleum Engineers oil and gas reserves committee and the Society of Petroleum Evaluation Engineers reserves definition committee that reviewed and approved the SPE-PRMS. Filler also prepared corporate reserves documents that recommended changes in reserves reporting to the U.S. SEC.

Before joining Ryder Scott, Filler was the corporate reserves manager at High Mount E&P Co. for two years and a senior staff reservoir engineer at Southwestern Energy Co. for three years. He evaluated corporate reserves, reviewed business development prospects, prepared production and cost forecasts and performed economic evaluation for prospects in U.S. and international onshore basins.

Filler worked for 11 years starting in 1998 at Devon Energy Corp. and was the commercial evaluation supervisor and senior advisor in corporate reserves in strategic planning. He was also a reservoir engineering advisor for the Gulf of Mexico properties.

While at Devon, he developed corporate economic evaluation standards and was on the peer review committee that focused on all major exploration projects worldwide. Filler reviewed reserves for compliance with U.S. SEC regulations and provided guidance across all divisions.

He prepared corporate reserves policy to ensure proper classification and categorization of reserves and resources. After serving in the United States Army for four years as an infantry officer starting in 1974, Filler began his career at Sedco Inc. as a drilling engineer in training. He also was a reservoir engineer or senior reservoir engineer at Golden Engineering Inc, Core Laboratories Inc. for five years and held engineering positions at CSX Oil & Gas Corp. / Total Minatome Corp., Energy Development Corp., Amax Oil and Gas Corp., Gulf Indonesia Resources Ltd. and Pioneer Natural Resources Co. before joining Devon.

Filler is a member of the Society of Petroleum Evaluation Engineers, Society of Petroleum Engineers and American Association of Petroleum Geologists.

He is a licensed professional petroleum engineer in Texas. Filler has BS and MS degrees in petroleum engineering from Texas A&M University and the University of Houston, respectively.



Sharp

Also, **John F. Sharp** joined Ryder Scott as a senior petroleum engineer. Previously, he was a manager of corporate reserves at Chesapeake Energy Corp. for seven years. Sharp managed engineers and technicians in maintaining the corporate reserves and economic databases. He managed and prepared quarterly reserve reports, year-end SEC reporting and other reports. Sharp also managed the implementation of a reserves management system.

Before that, Sharp was senior staff reservoir engineer at Anadarko Petroleum Corp. from 1996 to 2007. He was also a senior technical lead in the engineering systems group responsible for economic software. Before that, he worked for two years at Basin Exploration Inc. as a reservoir engineer in acquisitions and divestitures. He was also a senior evaluation engineer at Lee Keeling & Assocs. Inc. from 1982 to 1992.

Sharp conducted reserve evaluations and reservoir studies for public and private companies and investment houses. Sharp started his career at Shell Oil Co. in 1976 where he was a production engineer for two years. He also worked at Amerada Hess Corp. and Aramco before joining Lee Keeling.

Sharp has a BS degree in petroleum engineering from the University of Tulsa and is a member of SPE.

## Ryder Scott makes board and management changes

The Ryder Scott board of directors has two new members: **Larry Connor**, managing senior vice president, and **Dan Olds**, who was recently promoted to managing senior vice president. The board now has nine directors.

The new manager of Ryder Scott Canada is **Lynn Kis**, who was promoted to senior vice president. **John MacDonald** was promoted to vice president at the Calgary office.

Articles on Kis and MacDonald were published in the October-December 2013 and July-September 2013 *Reservoir Solutions* newsletters, respectively. All resumes are posted on the website, including those of Connor and Olds.

# Incorporating risk, uncertainty in resources evaluation

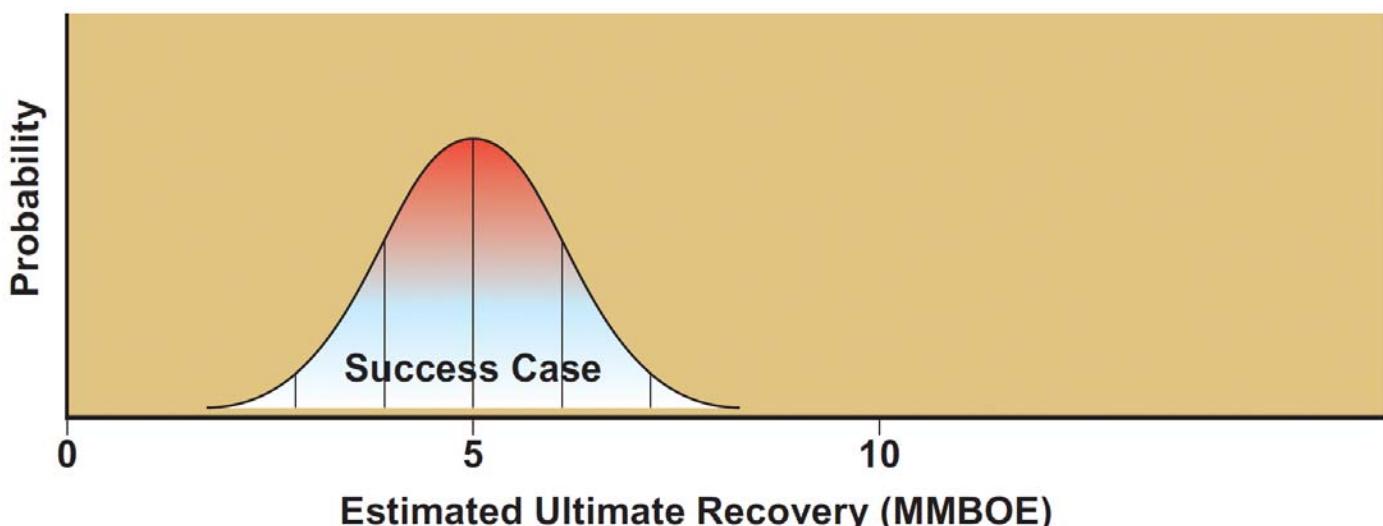
— Larry Connor, managing senior vice president and primary contributor

Two questions have always challenged those trying to find a balance among cost, potential and risk in oil and gas exploration. If a well is drilled, what is the chance that it will be a success or a dry hole? If it is a success, how big will it be?

These questions have never been more crucial than today as companies decide how and whether to invest in the exploration of undrilled oil and gas shale plays worldwide.

Typically, after integrating seismic interpretation with regional geologic data, an evaluator estimates the magnitude of a prospect (size of the find) for a range of successful outcomes through stochastic methods. P10, P50 and P90 results are derived by incorporating distributions into a volumetric model. The results are commonly referred to as the low, most likely and high cases, respectively—and represent the ranges of potential resource size after success. See Figure 1.

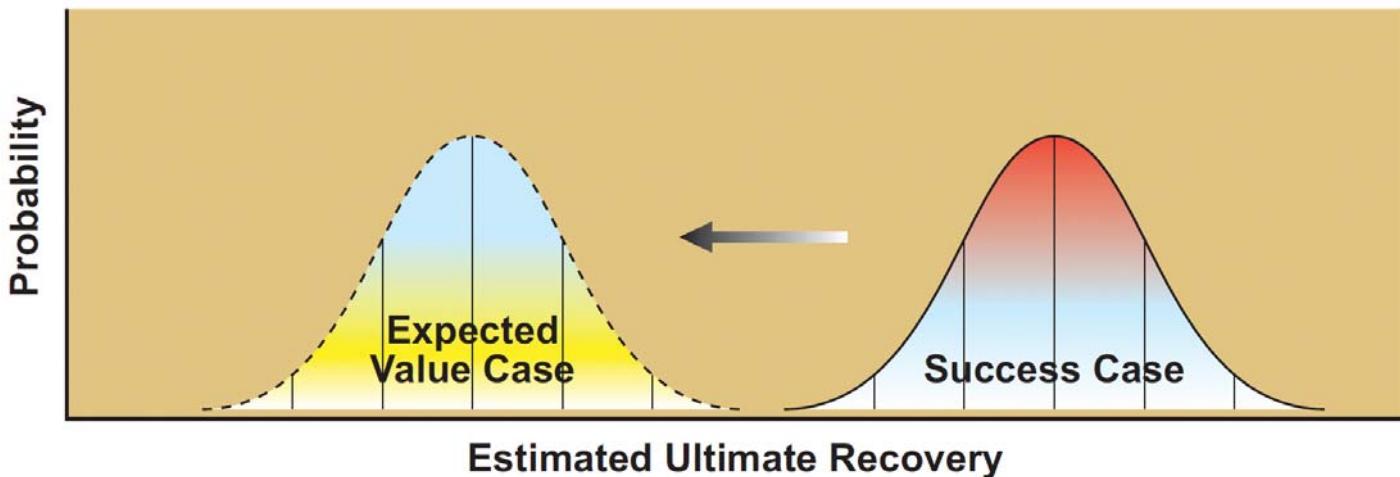
**Success Case Not Considering Geological Chance of Success—Fig. 1**



Then geologic risk factors are applied to determine the odds that any given well from a number of wells will be a commercial success. When an evaluator applies geologic chance of success (COS) to an exploration block, however, the calculation is not simple multiplication, i.e., COS x recoverable volumes. Rather the proper way to account for risk is to use a binomial distribution of a yes-no variable (0 or 1). Binomial distributions are used when a trial has two mutually exclusive outcomes—successful well or dry hole.

Geologists have used probabilistic volumetric models and risking to determine the probabilities of commercial discoveries on undrilled prospects for decades. However, some eschew binomial distributions in favor of the expected outcome method.

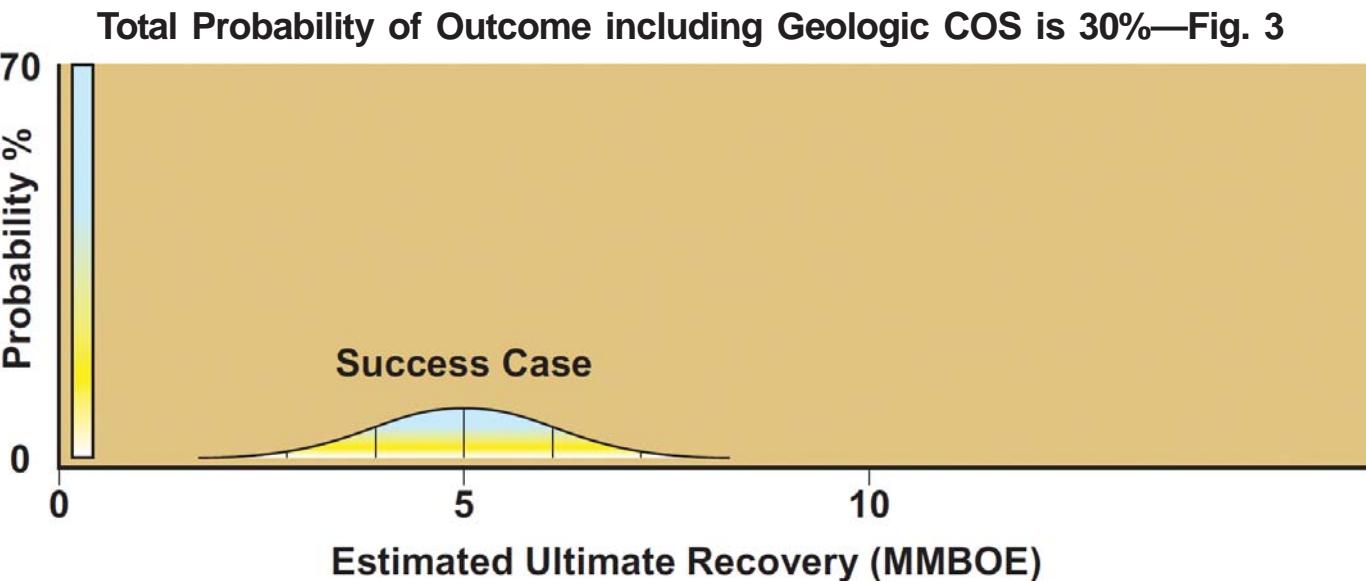
**Expected Value Approach Shifts the Success Case—Fig. 2**



In the expected value method, the geologic COS is multiplied by the success case to arrive at an expected outcome. That results in the success case sliding to the left on the distribution plot (Figure 2), i.e., probability and frequency (trials) on the y-axis and magnitude of recoverable hydrocarbons on the x-axis. In this scenario, results are always positive and no dry holes are drilled.

Also, the expected outcome method results in a non-realistic solution of the outcome, because a successful well will be on the original success distribution not on a reduced distribution. While it is true that if a sufficiently large number of trials are used the mean would trend to this distribution. The expected value method relies on many trials to achieve the geologic COS outcome. Most exploration programs are dominated by one or two drilling trials so the expected value method breaks down.

To better incorporate the true COS, the binomial distribution is used in stochastic analysis of exploration projects. In this way, unrisked volumes derived from the volumetric probabilistic model are properly balanced against the COS. See Figure 3.



#### Geologic risking with binomial distribution

Once the magnitude of a prospect is estimated for a range of successful cases, then evaluator considers the probability that one or more of the necessary conditions for success is missing. The evaluator must incorporate the probability of a failure event.

Geologic risk factors for conventional reservoirs include:

- ◆ Trap risk—Probability that adequate vertical and lateral seals exist that could confine hydrocarbons within adjacent reservoir rock.
- ◆ Reservoir risk—Probability that a lithology exists with sufficient porosity, permeability and continuity to contain moveable hydrocarbons.
- ◆ Source risk—Probability that a lithology exists with sufficient quantity and quality of thermally mature organic matter to have expelled oil or gas that feasibly could have migrated to the reservoir.
- ◆ Timing and migration risk—Probability that a source rock expelled oil or gas after the reservoir and trap were in place and that a flow path existed between source and reservoir. This includes the probability that subsequent geologic events did not cause excessive leakage, remigration or degradation of the trapped hydrocarbons.

Geologic risk factors for unconventional reservoirs include:

- ◆ Presence: Probability that target units of the prospective formation are present in the evaluated area.

◆ Organics: Probability that the target units of the prospective formation will contain sufficient organic material of appropriate kerogen type to provide for the generation of hydrocarbons.

◆ Maturity: Probability that the organic material contained in the target units of the prospective formation has sufficient thermal maturity to allow for the conversion of kerogen to oil and gas.

◆ Producibility: Probability that there are sufficient intervals within the target units of the prospective formation of sufficiently brittle composition and that the regional stress field is such that the application of hydraulic fracturing techniques may provide for movement of hydrocarbons in the reservoir to a wellbore at significant rates.

◆ Continuity: Probability that the other risk factors are favorable over a sufficient lateral area to allow for potential development of the target units of the prospective formation.

The total geologic risk = trap risk x reservoir risk x source risk x timing and migration risk (conventional reservoir). The COS does not include the likelihood that a development project in the evaluated area will be economically viable or, if viable, the likelihood that development will occur.

If the well is a success, then the value of 1 is multiplied by the range of recoverable volumes. The result is a success distribution of recoverable resources. If the well is a failure (dry hole), then the

*Please see Binomial on Page 8*

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**Binomial—Cont. from Page 7**  
 result is 0, leaving only dry-hole costs to consider.

As an example if an exploration well has a 10 percent COS, then 90 percent of the time, the well will be a dry hole. In this simple example, the well has zero recoverable resources until a 10 percent COS is reached.

Therefore the low (P90) and most likely (P50) cases are zero. Only at the high case (P10) would any resources be attributable.

#### Simple Example

Here is a basic example of how the binomial calculation works. In a binomial experiment, the probability of exactly X successes in n trials is the following:

$$P(X) = \frac{n!}{(n-X)!X!} \cdot p^x \cdot q^{n-x}$$

#### Notation for the Binomial Distribution

P(S)—Probability of success

P(F)—Probability of failure

P—Numerical probability of a success

Q—Numerical probability of a failure

P(S) = p and P(F) = 1 - p = q

n—Number of trials

X—Number of successes

Note:  $0 \leq X \leq n$

#### Example

Three wells are drilled. Find the probability of getting exactly two successful (economic) wells. Looking at the problem in the previous example from the standpoint of a binomial experiment, one can show that it meets the four requirements.

1. There are only two outcomes for each trial: Successful well or failure, e.g., dry hole.
2. There is a fixed number of trials which is three wells.
3. The outcomes are independent of each other (the outcome of one well in no way affects the outcome of another one).
4. The probability of a success is 1/2 in each case (COS = 50%).

In this case,  $n = 3$ ,  $X = 2$ ,  $p = 1/2$ , and  $q = 1/2$ . Hence, substituting in the formula gives the following:

$$P(2 \text{ successful wells}) = \frac{3!}{(3-2)!2!} \cdot \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^1 = \frac{3}{8} = 0.375$$

The answer is 37.5 percent probability of getting two successful wells.

**Comment Letters—Cont. from Page 4**  
 represented a material change to reserves, then the agency wanted Rex to provide a general discussion of the technology.

Halcon Resources Corp. booked PUDs more than one offset location from a producing well under the reliable technology rule. The SEC asked the company to quantify the number of those locations and the associated additional net proved reserves. The agency also asked Halcon to disclose if any well drilled to date that was more than one offset location away from a producer was determined not to be economically producible.

Wilson's study categorized comment letters by reserves issue for each of 44 companies and cited

**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 130 employees, including 90 engineers and geoscientists, Ryder Scott has the capability to complete the largest, most complex reservoir-evaluation projects in a timely manner.

key excerpts from those comments that went to the heart of the disclosure issues. Wilson will present his review at the SPEE Houston chapter luncheon in September.

**Coming**  
**Ryder Scott Calgary and Houston**  
 reserves conference details will be featured in the July newsletter issue. Also, the publication will focus on the Wolfberry play and comments to amendments to NI 51-101.

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