

# RESERVOIR SOLUTIONS

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*Responding  
to layoffs,  
SEC  
comments,  
lawsuits  
spurred by  
downturn*

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# Bakken study shows modified Arps is good tool when parameters have cutoff limits

**Stuart Filler**, vice president – project coordinator at Ryder Scott, said the modified Arps equation, when used with good engineering judgment, can fairly represent estimated future production performance from unconventional reservoirs. EURs should be calculated with limited ranges of b factors and initial decline rates, Di. Although modified Arps applies to boundary-dominated flow, it is the most widely used decline-curve analysis tool in the industry for wells in unconventional reservoirs, which have long transient-flow periods.

“It can be a good tool that yields acceptable engineering results in a minimum amount of time,” said Filler. To support that, he introduced his study of EURs in Bakken shale ultra-low permeability reservoirs at the Ryder Scott reserves conference.

Filler took monthly production from 1,500 horizontal wells, excluded those wells with no established trend and performed

curve fitting to estimate decline-curve parameters from type wells derived from three groupings of the remaining 900 wells.

The resulting values of b and Di had wide ranges with consistently high values of b. “It has been noted that Bakken wells often have long periods of transient linear flow, which results in b values of 2. For this study, b was constrained to a maximum value of 1.5 for the type wells,” he said.

Filler grouped type wells by EUR ranges and showed plots for the high, mid, and low cases. Please see plots below.

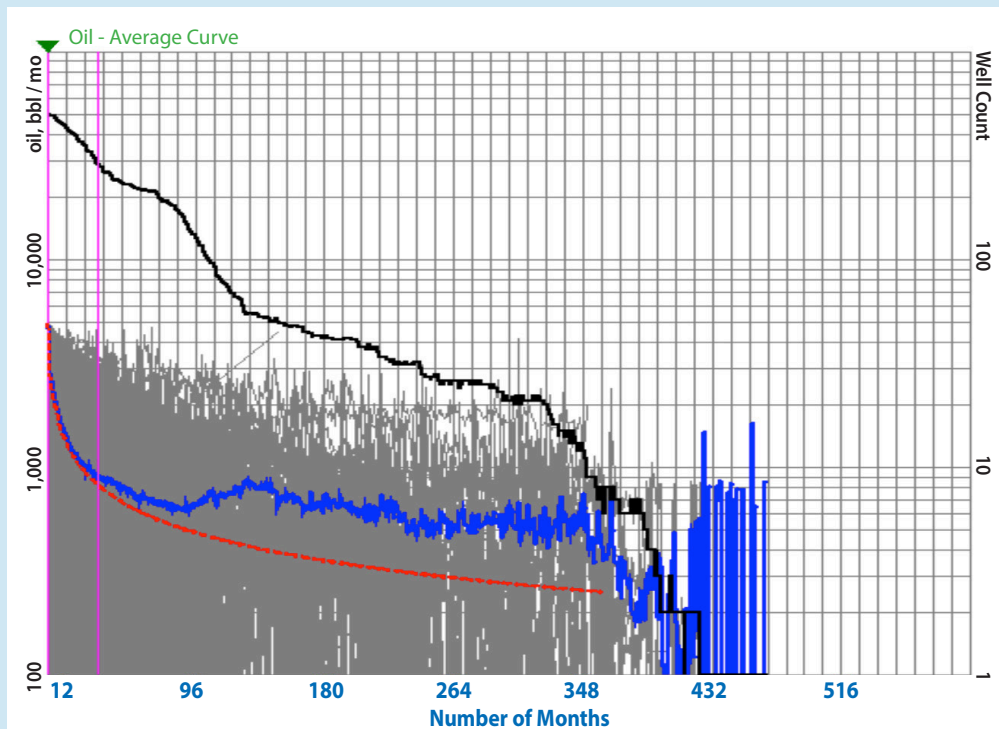
“Type wells using average curves from groups of wells appear to be somewhat different,” he said. “Poor wells did not have the same curve shape as good wells.”

Filler’s presentation is posted at the Ryder Scott website at [www.ryderscott.com/presentations](http://www.ryderscott.com/presentations).

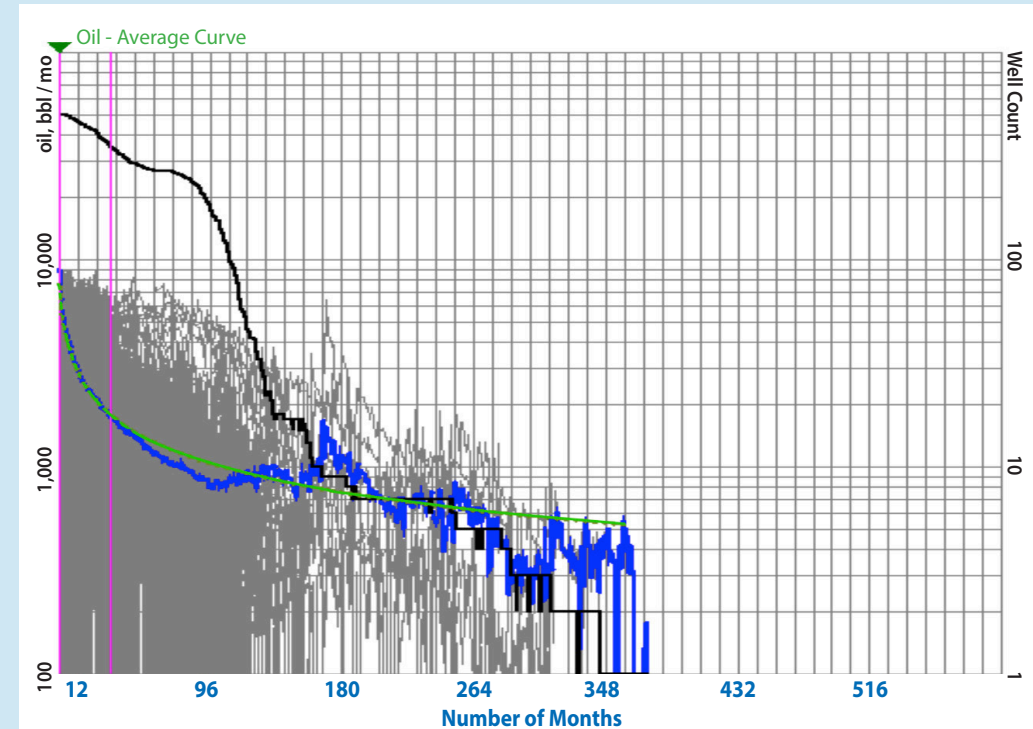


Stuart Filler

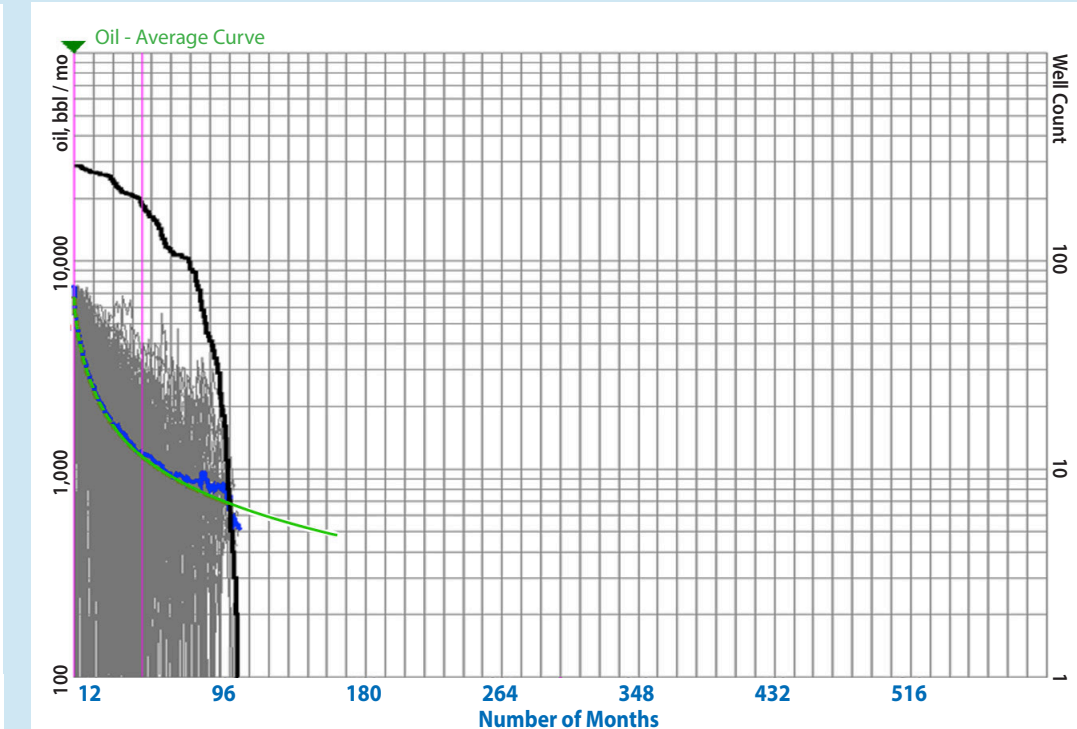
## Bakken Group 1 Wells (High EUR Case)



## Bakken Group 2 Wells (Middle EUR Case)



## Bakken Group 3 Wells (Low EUR Case) Curve fit b = 1.6 / Constrained b = 1.5



Well Count
  Historical Production-Rate Data for All Wells
  Average Historical Production-Rate Data for All Wells
  Type-Curve Approximation
  Type-Curve Approximation



## Legal issues in a low-price environment examined

With declines in commodity prices and corresponding announcements of reductions in capital spending and drilling activity, companies should expect the staff of the U.S. Securities and Exchange Commission to continue to focus on development of proved undeveloped (PUD) reserves, PUD capital expenditures and the SEC five-year limit to move PUDs into other reserves categories.

A recent SEC comment-letter survey conducted by Ryder Scott revealed reserves-related comments are increasing and often cover multiple years. Also, the survey showed PUD-related comments constitute more than one-third of all reserves-related questions.

Against this backdrop, **James Cowen** and **Jeffrey Elkin**, attorneys and partners at Houston-based law firm Porter Hedges LLP, presented, "Legal Issues in the Low Price Environment," at the Ryder Scott reserves conference.

Elkin said that low prices lead to an increase in civil lawsuits. As a result, "you may have to deal with subpoenas that you have to comply with," he remarked.

### SEC comment letters

Cowen presented tips to companies preparing to respond to an SEC comment letter. They are as follows:

#### Assemble team and assign leader to coordinate comments.

#### Determine due date and request extension, if necessary.

- Securities Act filings—Generally no deadline, but filing will not be declared effective until comments are resolved.
- Exchange Act filings—Generally a deadline of 10 business days.
- SEC staff typically grants written requests for reasonable extensions.

#### Analyzing and responding to comment letter

- Determine if comments are understandable; contact SEC staff for clarification.
- Complying with staff's request can quickly resolve comments.
- Review publicly available comment letters for prior staff positions.

- Repeat SEC staff's comment and then list company's response.
- If revised disclosure is being provided in an amended filing, letter should specifically disclose location of revised disclosure.
- Standard practice is to provide SEC staff with redlined hard copies of revised filings as a courtesy.
- Delivery of separate overnight packages for each relevant staff member can expedite review.

### Civil lawsuits

A subpoena is an order issued by the court that commands a company or person to produce documents, give a deposition or both when the underlying lawsuit is pending. "The first step is to read the subpoena and determine what it is asking you to do. Also note the due date," said Elkin.

The subpoena will include a date by which the action must be taken. "Clients don't pay attention to that," Elkin remarked, adding that under Texas rules, the due date is the

advice. A lawyer can advise you on whether the subpoena is overbroad, imposes undue burden or contains vague and ambiguous terms and therefore is objectionable," Elkin said, adding that making objections shifts a burden to the party that served the subpoena.

"They then are required to go to court to get an order to make you comply," he remarked.

Elkin said that lawyers can advise on where the served party has to search to find responsive documents. He offered an example in the recent "Deflate-gate" case in which the National Football League accused the New England Patriots football team

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*"Attempt to resolve comments at lowest level possible."*



James Cowen



Jeffrey Elkin

- Exchange Act filings – Deliver revised/clarified language and agreement to include language in future Exchange Act filings. Typically acceptable to staff and preferable to amending previously filed documents.
- Comment may require issuer to provide supplemental information.
- Address the comment as fully as possible without providing irrelevant information. Too much disclosure can lead to additional comments. Response formulation can be more art than science.

#### Difficult comments may require phone calls/internal appeals.

- Limit phone calls to one or two comments.
- Attempt to resolve comments at lowest level possible.
- Advise lower level staff of appeal to a higher level.
- Note that a difficult comment has likely been reviewed by supervisors and support offices.
- Act professionally and treat the SEC staff with respect.

#### Formatting of response letter

- Numbering format should be the same as the comment letter.

last day that the party served by the subpoena can serve objections.

"After the due date, legal objections to the subpoena may be waived," he said. "To preserve your objections, serve them before the due date."

Also, failure to comply with a subpoena is contempt and punishable by fines or confinement. "That is an extreme situation and rarely happens but it is in the rules," said Elkin.

Also, he advised to get legal counsel involved, whether it is an in-house lawyer or outside attorney, when served with a subpoena.

"This is not the time to play lawyer. It is important to get legal





*Legal issues – Cont. from Page 5*

of tampering with footballs used in a championship game.

“One interesting point is NFL investigators got a lot of information from cell phones of Patriots employees,” he said. “Law is developing in this area. A lawyer can help you navigate through those waters.”

Elkin also advised that if a served party is required to give a deposition under oath, then that party should get a lawyer. “Deposition testimony is given under oath and is, therefore, subject to perjury,” he said. “It’s not like a conversation with a friend at a coffee shop.”

Elkin added, “You need assistance about how to respond to the questions asked during a deposition, particularly since everything that is said is taken down by a court reporter. You would be shocked at what is sometimes said at a deposition. Don’t walk into a deposition without a lawyer or before you have consulted with a lawyer.”

Employment disputes also increase during an economic downturn. Employee layoffs in the oil and gas industry have been reported almost daily. Elkin said that because Texas is an at-will employment state, an employee can be fired at any time with or without cause.

The exception is if the employee and the employer have previously entered into an employment contract. He said that most employment contracts contain a non-compete provision, which is a restriction on post-employment activities. It aims to prevent a former employee from working in a chosen profession, hiring former co-workers or soliciting former customers of the employer.

Elkin said that Texas courts will generally enforce a non-compete if it is supported by an exchange of valid consideration. An example of an exchange is when the employer states that it will give confidential trade secrets or business information about the employer to an employee if the employee keeps the information confidential. “It is an exchange of promises,” said Elkin.

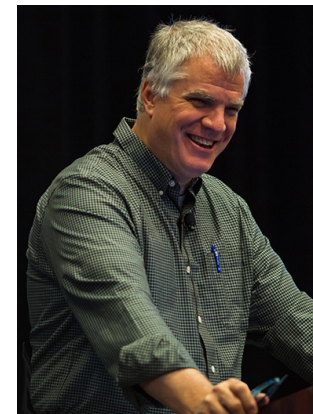
A non-compete has to contain reasonable restrictions on activities, scope, time and geography. In other words, a non-compete that states that the former employee cannot be in the same business until 10 years after leaving the company is likely to be found by a Texas court to be unreasonable.

“Reasonableness is constantly being resolved in court. There is no one size fits all. It is extremely fact intensive,” said Elkin. “The bottom line is there are lots of landmines you may not know exist. There may be issues in this area that you don’t know that you don’t know.”

The presentation is posted on the Ryder Scott website at [www.ryderscott.com](http://www.ryderscott.com).



## Co-developer of power-law exponential says focus on data, not model



*Tom Blasingame*

**Tom Blasingame**, a professor in the department of petroleum engineering at Texas A&M University, presented, “Reservoir Engineering Aspects of Unconventional Reservoirs,” at the latest Ryder Scott reserves conference. He has received 15 awards/honors from the Society of Petroleum Engineers, Texas A&M and the Texas Independent Producers & Royalty Owners Association.

Blasingame discussed decline-curve analysis and rate-time-pressure analysis for unconventional reservoir systems as well as modeling of ultra-low permeability reservoirs.

“Time-rate-pressure analysis requires a reservoir model,” he said. “Many people are using proxy models rather than a full analytical or numerical reservoir model. That’s OK, but using a proxy model can get you into trouble. We should go back to the original fully functional models.”

Blasingame also pointed out that chaotic operational issues can confound simple time-rate analysis. He distilled parameters involved in shale well performance to porosity, permeability, reservoir thickness and well placement and emphasized “defining factors” as natural fractures, overpressure, thermal maturity and well spacing and stimulation.

“Is well spacing really the Holy Grail? If you want to test well spacing, bigger is not better. You need to go to the smallest (closest) possible well spacing to start with,” said Blasingame. While recognizing current cost controls in a low-price environment, he said, “We need to carpet bomb a few of these plays and see what happens.” He added, “You get there by experiment, not design,” in discussing stimulation stages and perforation clusters.

Blasingame assisted in developing the application of the power-law exponential time-rate decline-curve model that, among other functions, approximates early-time well behavior in tight and ultra-tight formations. “Can early EUR be meaningful? This is not a strong and steadfast rule from my personal standpoint, but as a

recommendation, I don’t think that anyone should estimate EURs with less than 18 to 36 months of production in an unconventional play,” he said.

Blasingame has explored old and new techniques used to estimate reserves with a few surprises. “I stood up five years ago and said that anyone who runs pressure-transient testing in a shale ought to have their head examined. You don’t ever get used to the taste of your shoe. I was wrong. We ought to be doing a lot more of this,” he remarked.

Blasingame also commented on the somewhat-controversial use of the modified Arps equation for estimating production declines in unconventional reservoirs. “I was not a fan of reserves estimation with Arps, because I didn’t realize that evaluators in general have been doing this for years and have put a terminal tail on it. After a lot of work in this area, I am OK with it,” he remarked, “I can live with it. It’s kind of like the dollar. Its popularity goes up and down, but in the end, everybody wants to use it.”

Eight years ago, Blasingame and his research team created an application of the power-law model to better match production-rate behavior from tight formations when compared to hyperbolic rate decline. “In 2007, I was presenting some work on the Arps decline-curve model to predict performance in vertically fractured wells using a simulation study, and someone in the audience asked, ‘Why don’t you just come up with a universal time-rate decline curve equation?’ I went back to the drawing board and thought about this,” he said.

Blasingame found that evaluators focused on the models, not the data. “Are we defining the model to match the data, or are we using the data to define the model? I was really struck by that concept so my team and I created a diagnostic plot and looked at D (decline parameter) and b (exponent) as a function of time and that is where the power law exponential came up,” he said. “You should always go back to the diagnostics and check the decline-curve model against the diagnostic data functions.”

For Arps, an evaluator can use derivatives D and b to define diagnostics and test whether a model is relevant. Blasingame’s slide presentation — which is heavily illustrated with charts, graphs and plots — is posted at [www.ryderscott.com/presentations](http://www.ryderscott.com/presentations).



## Low prices underscore need to incorporate uncertainties in business decisions



Larry Connor

**Larry Connor**, technical coordinator – advising senior vice president at Ryder Scott, delivered a presentation on the value of probabilistic analysis at the third annual Russian Oil & Gas Summit Exploration and Production in Moscow on Nov 11. The summit is supported by the Ministry of Natural Resources and Environment and State Commission on Mineral Reserves (GKZ) in Russia.

**Connor focused on incorporating uncertainty in reserves evaluations. He cited technical and commercial uncertainties as follows:**

- **Geologic**, for instance, in static reservoir modeling and calculations of in-place volumes
- **Engineering**, such as assessing drive mechanisms and estimating well productivity
- **Economic**, such as estimating future costs and product prices to generate discounted net present values

“Collectively, the myriad of uncertainties is a distinctive feature of the industry. Each uncertainty has a significant impact on decision-making and the success of field operations,” he said.

The oil and gas industry handles a multitude of uncertainties through stochastic modeling and analysis, which incorporates input-parameter uncertainty, and provides a range of expected values rather than a single-event value. That Monte Carlo simulation technique is used at various project stages including during volumetric analysis, production forecasting and economic evaluation.

“One of the advantages of the computer revolution is that now we have the ability to quickly run hundreds of thousands probabilistic iterations,” said Connor. Typically, a decision-maker combines multiple sources of uncertainty to produce a composite of total uncertainty and investigates the relationships among the model’s input variables.

“With the new era of reduced oil and gas prices, it becomes even more critical to properly incorporate uncertainties in business decisions. Of all the decisions that executives make,

none is more challenging than choosing among investment opportunities,” said Connor.

Probabilistic analysis provides an executive with a better understanding of the potential outcomes of an investment decision. “In turn, this allows for a relative comparison of investment opportunities while incorporating the uncertainties associated with input parameters,” said Connor.

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Dmitri Zabrodin

introduces economic limits,” on Page 8. FDP is an alliance partner of Ryder Scott.

At the Russian O&G Summit E&P, **Dmitri Zabrodin**, vice president at FDP Engineering LLP, delivered a presentation that compared the new RF-2013 classification system to the SPE-PRMS. For further information, see the July-September *Reservoir Solutions* article, “New Russian reserves classification system



## Oil price for year-end reserves filings with SEC plunges 47 percent

Annual average prices for reporting year-end petroleum reserves to the U.S. Securities and Exchange Commission plunged 47 percent for oil and 41 percent for gas, using WTI crude and Henry Hub benchmarks, respectively.

For 2015, WTI crude is \$50.28 a barrel and Henry Hub gas

is \$2.58 per MMBTU. Other benchmarks and information on using differentials are posted at [www.ryderscott.com](http://www.ryderscott.com).

The prices are based on the unweighted, arithmetic average of the first-day-of-the-month price for each month in the calendar year. E-mail inquiries to [fred\\_ziehe@ryderscott.com](mailto:fred_ziehe@ryderscott.com).



## Geologist joins Ryder Scott

**Olga V. Logvinova** joined Ryder Scott as a senior geologist with more than 24 years of geology experience in the petroleum industry. Before that, she was a leading specialist at Moscow-based FDP Engineering LLP where she had conducted geological analysis since 2006.

At FDP, Logvinova evaluated oil, gas and condensate reserves based on international standards. She estimated hydrocarbon resources working with Ryder Scott on assets in the following countries: Azerbaijan, Kazakhstan, Libya, Malaysia, Ukraine, Venezuela and Russia.

Some of Logvinova's major evaluation projects in Russia were in the following regions: Khanty-Mansyiskiy Autonomous Okrug, Krasnoyarskiy Krai, Timan-Pechora oil province, Volga-Ural oil province, Komi Republic and Republic of Yakutiya (Sakha).

Before that, she was a senior specialist at United Consultants FDP. Logvinova joined the consulting firm in 2000, and worked for five years in the E&P department. Among her major projects, she prepared geological data and performed reservoir engineering analysis of the Priobskoye field in western Siberia for Yukos Oil Co.

Logvinova also processed geological and petrophysical information, analyzed and evaluated reservoir properties and generated 3D geological models for the Sredne-Balykskoe oil field for Yukos Oil Co. and the Vazeykoe oil field for Lukoil-Komiktek.

She reviewed well stock geological data at Varyeganskoye oil field and prepared maps for Slavneft-Varyeganeft.

Logvinova was a lead engineer at the All-Union Oil And Gas Research Institute during 1992 to 2000. She performed scientific research in the automation of geological modeling processes at prospect and reserves-estimation stages.

Logvinova assisted in field-development design and reservoir management. She conducted geological modeling of Talinskoe and Vanyeganskoe oil fields and Lyantorskoe and Fedorovskoe gas-oil fields in western Siberia for development planning and management.

Logvinova also created a database for the Talinskoe and Vanyeganskoe oil fields, analyzed and evaluated the reservoir properties and correlated the cross-sections. She began her career in 1990 as a geologist for two years at Mangyshlak Geophysical Expedition in Aktau. She processed and interpreted well log data coupled with seismic data for regional and prospect evaluations.

Logvinova has BS and MS degrees in geology from Moscow University of the Oil and Gas Industry. Her native language is Russian and she is fluent in English.



*Olga V. Logvinova*



## Ryder Scott reserves conferences scheduled

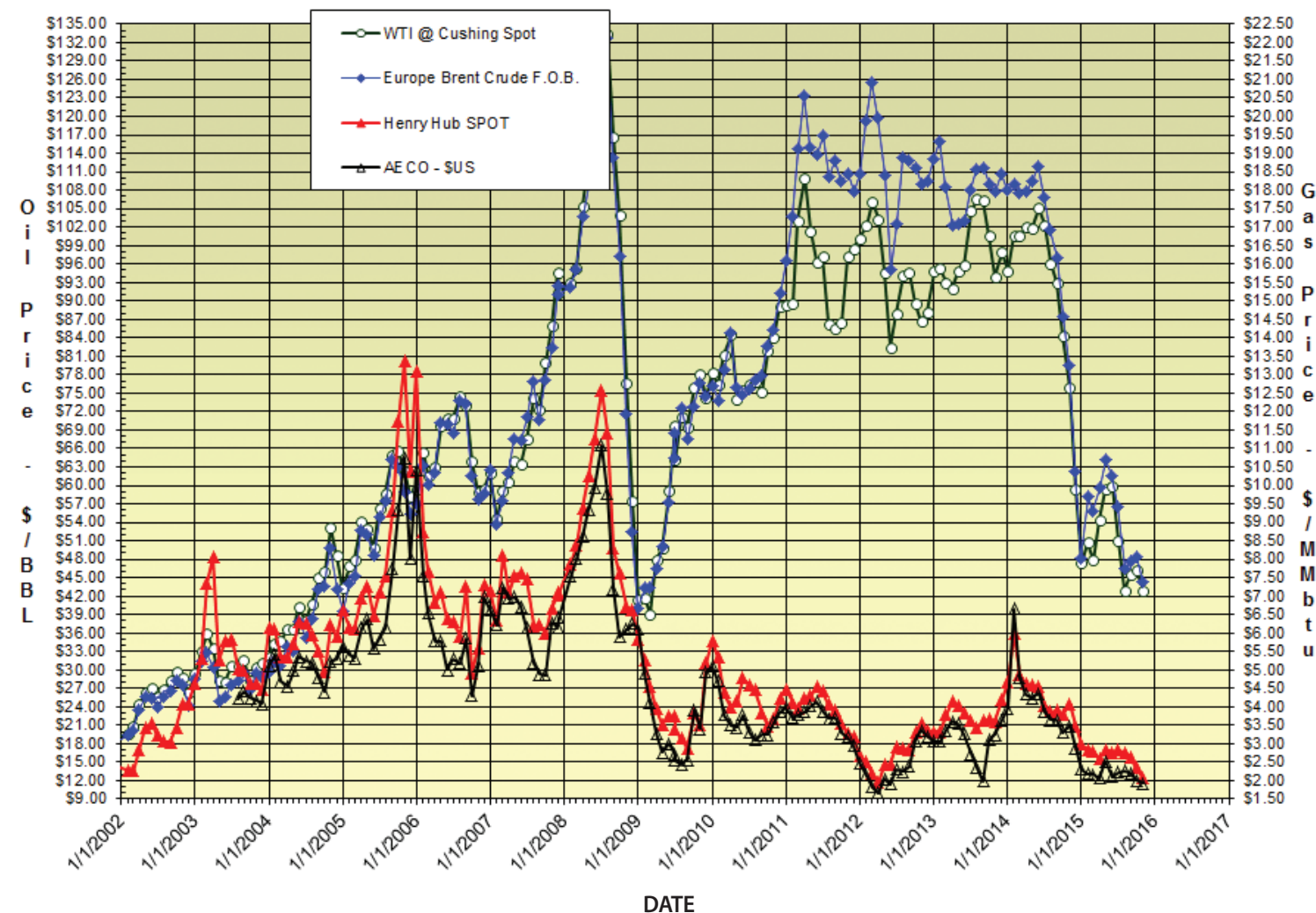
The Ryder Scott Canada reserves conference will be held Tuesday, May 10, at the Hyatt Regency hotel in downtown Calgary. Invitations will be emailed early this year.

Canadian petroleum reserves experts, scheduled throughout the day, will discuss current topics in the oil

and gas sector. For an invitation, please send an email with your business card information to [ConferencesCalgary@ryderscott.com](mailto:ConferencesCalgary@ryderscott.com).

The 12th Annual Ryder Scott Reserves Conference will be held on Tuesday, May 10, at the Hyatt Regency hotel in downtown Calgary. Please see *Ryder Scott conferences scheduled on Page 12*

## 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.



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*Ryder Scott conferences scheduled – Cont. from page 11*

held on Wednesday, Sept. 14, at the Hyatt Regency hotel in downtown Houston. This event is the single largest gathering of reserves evaluators in the world, attracting 350 oil and gas professionals annually.

The day-long conference is geared towards professionals interested in keeping up with the latest practices in estimating and reporting oil and gas reserves. Attending licensed petroleum engineers will receive credit towards their continuing education units depending on the hours spent at the conference and state requirements.

For example, the Texas Board of Professional Engineers requires licensed engineers to take 15 professional

development hours (PDH) per year; at least one PDH must be in professional ethics, roles and responsibilities of professional engineering or review of the Texas Engineering Practice Act and board rules. The ethics presentation at the conference fulfills the one-hour annual requirement.

Larry Connor, advising senior vice president, manages both events. Email requests, questions or comments to [RSCConfHouston@ryderscott.com](mailto:RSCConfHouston@ryderscott.com). Ryder Scott will send invitations to the conference via email.

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*Reservoir Solutions* newsletter is published quarterly by Ryder Scott Co. LP. Established in 1937, the reservoir evaluation consulting firm performs hundreds of oil and gas reserves 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.

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