APPRAISING OIL & GAS PROPERTIES

A Newsletter for Appraisal Professionals

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Way Down Yonder in the Land of Cotton We have just returned from a 10-day sojourn in Georgia and South Carolina during which we visited relatives, took in many cultural and historical points of interest, and attended the SPEE Annual Meeting in Charleston. The SPEE meeting was a rousing success and, while this newsletter was written before we left on the trip, the main topic of Risk Adjustment turned out to be a source of lively discussion at the meeting.

Late Sports News I know it is a bit late for football news but I own this space and hate to miss an opportunity to gloat. As we went to press in December our guys, victors over both UCLA and Notre Dame, ably led by Heisman Trophy Winner Carson Palmer, and accompanied by Song Leaders, Cheer Leaders, Horses, Mascots, and throngs of grateful alumni were off to play the real Rose Bowl Game down in Miami (of all places) against those (higher rated) Big Ten guys from Iowa (Buckeyes, Hawkeyes, Blackeyes, something). Great Hoopla and anticipation, press hype, prime time TV - the whole bit. Finally, it was time to play. The Iowa folks came out on the field, got the ball, ran one play, and thoroughly scared the bejesus out of all the hardy faithful who had either spent gobs of bucks to travel to the game or in some cases - as yours truly - turned the TV on 30 seconds late. They then promptly left town and were not heard from again until reallly late in the 4th Quarter. Great game - football. Who needs pros! LA has not had a pro team for, what!- 6 years. When the Raiders left town the crime rate went down. Oh, the score you ask:

USC - 38 Iowa - 17

Smokey the Bear Would Make a Good Rug Remember how I told you that late last summer the Forest Service had come through and cut a fire break along the edge of the national forest near the cabin? Actually about 100 yards away. They had piled all the cuttings and were going to burn them. This was a major concern and source of great angst but a few wet winter months went by and, as the result of firewood supply forays by some of the locals, the piles did get smaller. We began to worry about the dry season coming up but hoped that common sense had taken hold. No such luck. A couple weeks ago, with no notice whatever given to property owners, the Forest Service, those wonderful fellows with the talking bear who is always telling us to be careful with fire in the woods, came along, lit their matches, and burned the debris piles - and damned near burned the whole place down. There must not have been any adult supervision because several big (40-50 ft.) pinion pines were either burned up or were so badly scorched that they will not survive the summer. Then there are the couple dozen smaller guys, who finally had reached substantial (4-5') growth (not easy up there) that were burned up. So, where we used to have a well-balanced but admittedly dense mix of pine and oak, full of deer, quail and coyotes we now have a 40-yard wide stretch of ground that looks like a mine-field full of burned trees, tree stumps, uprooted and broken sage, and piles of ashes. Once again, Government is your friend.

Coyotes We have not seen our resident coyote family since Smokey came around to protect our natural resources. Too bad. Should they return, however, we have decided that the names hitherto bestowed on them, Maurice and Clarice, sound just a bit "Old Europe"- to use a Rumsfeldian term. In absentia, we have renamed them Fred and Ethel.

Otters Win! Several newsletters past (see Website under Newsletters), we carried a story about the on-going battle between the local fishing persons and the slowly growing colonies of sea otters that are beginning to reestablish themselves along the Central California Coast. Otters, being known as epicureans, are very partial to abalone and other high-priced shell fish. For years now, U.S. Fish and Game, kissin' cousins of the Forest Service but without the Bear, has been trying to (a) re-locate and then (b) restrain the otters in selected ecologically advantageous habitants away from important commercial fishing areas. There was even a formal agreement to that effect between the government and the fishing folks. The problem is that the otters cannot read either the agreement or the No Otters Beyond This Point! signs, and since otter guards - unlike cattle guards - do not work, the furry crustacean munchers pretty much went where the fishing and the living was easy. What is good for fishing persons should be great for otters, right! Relocation of a bunch of the culprits to San Nicolas Island did not work either, they simply back-stroked across the Santa Barbara Channel and took up residence wherever they liked the view. The fishing persons sued the Feds, the Feds responded that they could not control the otters and, well, the otters won. The agreement is out. The moral is, if you like abalone, expect to pay more for it.

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The Use and Misuse of "Risk Adjustment Factors"

In our last newsletter (December, 2002) there was some discussion of the role of so-called "Risk Adjustment Factors," otherwise known as RAF's, in the valuation of oil and gas properties. The proximate cause of that discussion was a property tax dispute here in California. But that is another story. (See below) It was also a topic of significant interest at the recent SPEE Annual Meeting. The topic of risk adjustment has been raised to a higher plane of awareness but not necessarily knowledge by that litigation and, rather than just let the issue drift off into the sunset, this might be a good time to cast a bit more illumination into some of the odd nooks and crannies of the subject.

What do we Mean by Risk Adjustment?

It is important to carefully consider what we mean by "Risk Adjustment." If we mean the attempt to modify our estimates of future expectations by introducing an element of compensation for the possibility that those expectations may or may not be met in the manner or abundance that we project, then risk-adjustment is a very old and time-honored concept. It has to be at least as old as commerce amongst people and could possibly go back to the first cooperative mammoth hunt, the first trade, the first investment, the first time someone said, "I will pay you Tuesday for a hamburger today," or some such. The concept probably goes back even farther than that. After all, every time we have to make a choice between outcomes there is a chance that one or the other outcome will not turn out as expected and that we will win or lose accordingly. Whom do you suppose did the risk-adjustment in this scenario: "If you bite into that apple you may have to leave the neighborhood!" Pretty risky but, hey, who would know? What do you suppose were the odds on Noah's building contractor being done before the rainy season? Was the risk of non-completion factored into the contract price?

Moving along to a later time, imagine Ferdinand and Isabella (old time Spanish royals circa 1492) parked in the throne room debating whether to finance a itinerant Italian sailor who is trying to convince them that he can open trade with China by sailing west. We hear Isabella say, "How much does he want again , Ferddy?" To which Ferdinand replies, "The last budget was for three ships, a crew and some pocket money in case he finds a hot spot or two - 30,000 pesetas or so. This Columbus guy likes to party"... "Oy Vey, that's a lot of bucks. I may have to hock the jewels again. So he gets to China - what does that do for us?"... "Well, you know this "world is round" stuff is all UnProven but if he is right and we could wangel a good trade agreement, we could be doing alright in a few years - you know, empires, Armadas, Corinthian leather in the carriage, all that stuff. It's worth a try, Isabella,"... The Queen sighs heavily and responds "Sure, Ferddy, sure. But there is a big downside - after all, we are not all that flush after kicking the Moors back to Africa and, from what I hear, the Portuguese seem to think this Columbus is a few sails short of a galleon"... "Not to worry. The money is minimal. We may have to raise the taxes on bull fights or something. The downside is we loose a few old ships and we do not have Columbus pestering us every time we turn around. Come to think of it, that could be a good thing!" ... "Ok, give him the money but I'll bet you 20 to 1 we never see him or the money again - probably sail right off the edge or get swallowed by a dragon." [Note to Reader: There is no historical evidence that Ferdinand and Isabella had this conversation or that they risk-adjusted their investment but, then again, what are the odds that they did not?]

Applying a 5% risk adjustment factor to the likelihood that Columbus would return and provide Spain with the wealth of an empire may seem somewhat arbitrary in comparison to the loss of - well, not much - the ships barely stayed afloat. But at least it would be an attempt to rationalize expenditure with expected return. Our example is also a bit simplistic compared to modern oil industry practice. While the original investment of is known, Ferdinand might have done a few income projections based on future gold, silver and coffee production compared to the costs of Cortez, Pizarro, and Montezuma's revenge and then assigned a likelihood of occurrence to each one. He could also have expanded his knowledge base by checking with the Norwegians who had, after all, been there before. But then, neither he nor Isabella were counting on Columbus getting lost and stumbling on the Bahamas. This is, of course, all in fun but it helps to ease into the dull stuff.

Interest as Risk Adjustment

The first real manifestation of risk adjustment in relation to investment was the invention of usury which is better known by the financial term, interest rate. This pothole in the road to Man's future occurred exactly 10 minutes after Shadrack, a tax assessor in an Old Middle Eastern Kingdom, coined the first "money" (thought to have been in what is now Iraq sometime before the Marines got there) and just about three seconds after both Meshack and his neér-do-well brother-in-law, Abednego, expressed a desire to "borrow" said coin. Knowing that Meshack was a trustworthy pillar of the community but that Abednego did not have two sheep to rub together, Shadrack loaned half the coin to Meshack at 5 % per week but charged Abednego 20% per week. He also introduced both Meshack and Abednego to his longtime buddy and newly appointed collection supervisor, Guido.

From that day to this, interest rates have served as a very flexible and easily applied means of compensating an investor for both the actual and the perceived risk(s) associated with an investment. Interest rates, along with the price of gold,

have been reasonably reliable indicators of risk in capital markets, and the economy in general, for most of recorded history and particularly since the start of organized trade. As Adam Smith wrote in *The Wealth of Nations, "The creditor will not lend his money for less than the use of it is worth, and the debtor must pay him for the risk that he runs by accepting the full value of that use."*[1] The language is somewhat archaic but it means that the interest rate charged is a function of the risk of the investment - the likelihood that the investor will receive his money back. This relation is very easily seen in a comparison of interest rates for various classes of debt instruments as reported everyday in the newspaper. The best and lowest risk investments, such as short-term U.S. Treasury bills, have the lowest interest rates. As the term of the investment and the risk increase so does the interest rate. As of May 5, 2003 twenty-year Treasuries are 4.85% while corporate AA's and BB's are about 5.58% and 6.17% respectively. The interest rate is a measure of the Return-on-Investment that is required by the investor for the use of his money. The obverse of the interest rate/required return relation is the discount rate. When the expected income from an investment is discounted at a rate that includes consideration for risk, the discount rate serves the same risk-related function as the interest rate.

It should be apparent that interest rates and discount rates have provided a way of recognizing investment risk for a long time and do it quite well. One does not need to be Gordon Gecko (of "Wall Street" fame) to figure out that, if one is to make 5 investments of $20,000 in each of five projects of increasing risk, then it is reasonable to require higher interest rates (returns) on the higher risk projects or conversely to discount the anticipated return from the projects with greater perceived risk at a higher rate. But, as investors and the evaluators retained by those investors have become smarter and/or better educated (not necessarily the same thing) and not being content to leave well enough alone, the concept of risk-adjustment factors was born. I have spent some time trying to track down the origins of risk factors - at least the application to the oil business - but the source remains elusive.

Risk Adjustment - General View

The idea of the "Risk Adjustment Factor" is that the particular or unique "risk" in a specific investment can be separated from a minimum or consensus level of acceptable return for all investments, or investments of a certain type; and that, by adjusting the anticipated future rewards to account for the unique risk(s), all the investments can be compared on the same risk (or lack of risk) level. Note that three subtle but nonetheless very important shifts in perspective are implicit in the risk-adjustment methodology.

1. The process involves investment that will return a stream of future income.
2. The operational parameter is the discount rate.
3. There are limited funds for investment. Otherwise no comparison would be necessary.

The risk adjustment concept has numerous advantages over the single discount rate approach. The primary advantage is flexibility particularly where investments in complex income streams are being contemplated. Moving right to our business, an income stream for an oil property can consist of (a) projections of production for one or more products (oil, gas, water), (b) projections of development schedule(s) for future production such as drilling, remedial work, etc., (c) projections of prices for each product, (d) estimates of future operating costs, production/severance taxes, and other costs, and (e) estimates of future capital expenditures to accomplish all the above. In theory, the likelihood that each of these components would be obtained as expected could be determined (or at least estimated) and quantified. If that likelihood can be quantified then the expectation, perhaps in the form of a percentage, can be applied to that component of the projection and a "risk-adjusted" production projection (or development schedule or price projection) can be obtained. The combination of these risk-adjusted components into an overall income stream results in a risk-adjusted cashflow that can be reduced to present value at whatever consensus discount rate is used for capital budgeting or investment selection.

Of course, it is not necessary to risk adjust each component of the income stream. In many cases an overall risk adjustment factor will do. As an example, let us imagine that a savvy investor, Fred, has three investment opportunities that he can fund. His cost-of-capital plus return-of-investment is 18% BFIT. The three projects have identical expected income streams but B is twice as risky as A and C is half again as risky as B. In one form of the RAF methodology, if A has a risk factor of 1.00 then B would be reduced by 0.50 and C by 0.75 before they can all three be discounted at 18% BFIT.

Hey, well, that was easy! Risk adjustment is no big deal, right? Let's think this through just a bit more before jumping on the RAF bandwagon.

- What are the benefits of Component Adjustment vs. Single RAF?
- How do I estimate the RAF?
- How does Risk Adjustment mesh with Probabilistic Evaluation?

Component Adjustment

In theory, if one can make a projection of future production or product prices, one should also be able to assess the likelihood that the projection will come to fruition as expected. Stabilized exponential declines are relatively easy to project with low error potential but new production (even in known areas), poorly maintained properties, or enhanced

recovery can be difficult to analyze let alone project. Operating costs are comparatively easy to estimate but oil and gas prices are not. If there is any part of an evaluation that you know will be wrong it is the product price projection. Should an evaluator attempt to devise one RAF for the production and another for the price projection? Or should he use the same price projection for all projects and only risk the production? If you use separate adjustments are they additive? That is, if the production projection and the price projection are risk-adjusted using different factors, can the risk-adjusted values be multiplied together to obtain a revenue steam? They probably are additive but to a certain extent that may be a function of how the production and price RAF's were derived.

Let us throw in another complication. At the start of the production projection there may be more likelihood of error that there would be after, say, three years of production. Should one use the same risk adjustment for every future year or should you change the risk adjustment in future years to reflect accumulated experience? In other words, if I start with a production projection and assign an RAF of 50% but then assume that if I looked back after three years I would have more history and would only risk the production by 25%. After 10 years, there might be no need for an RAF. This is a bit like supply-side economics in that it requires a constant assessment of conditions in the future based on events that are anticipated to occur as the result of actions taken today. Needless to say, like supply-side economics and other things worth doing, applying appropriate risk adjustment is not easy but, then again, life involves tough choices.

Estimating a Risk Adjustment Factor

What are the criteria for estimating an RAF? How does an evaluator quantify a risk adjustment factor for an income projection? One approach is to treat the RAF as an error factor. That is, the evaluator could make a projection of anticipated production from new development, using similar wells, etc. and say that there is a 20% chance that production will be to undertake higher or lower than projected. But is that a 20% risk or simply a 20%± likelihood of error? If the latter, the solution may be to undertake multiple projections at various error rates to arrive at an expected projection.

A better approach might be to separate the risk adjustment from the potential error in the projection and to base the risk factor on the **Quality** and **Quantity** of data available from which to make the projection. If there are wells in the same field/reservoir with production history, the risk associated with projecting new wells may be significantly less than if there are no wells in the field/reservoir or if the production history of the existing wells is short. To a certain extent, this approach would place risk adjustment factors along side the criteria used to define the reserve classification of the anticipated production. Many of the same criteria that are used to assign reserves as Probable or Possible can be applied to the selection of an RAF. There are already guidelines for this approach in the SPE/WPC reserves definitions which suggest large risk adjustments for Unproved reserves. That is, a property where the reserves are classed as PROB or POSS would have a higher RAF than if the reserves were PDP.

Risk Analysis and Probabilistic Analysis

There may be a point where risk adjustment analysis crosses over into Probabilistic reserve analysis. Probabilistic methods have their widest application to those evaluations where hard data, such as historical performance, is minimal and where error potential is greatest. Further, probabilistic analysis is most applicable (almost by definition) to statistically determinable data such as the components of an oil-in-place calculation or the estimation of future production but may have less application to data that is randomly variable such as pricing and other economic factors. On the other hand, projections developed through a rigorous Probabilistic approach should not then require risk adjustment of the statistically determinable components, except to account for data quality, but may require some consideration of risk for randomly variable components. It is, of course, interesting that Probabilistic evaluation has broadest application to the Unproved reserve classes which, by definition, have the least data in terms of **Quantity** or **Quality**, tend to represent the highest risk, and may therefore require the highest RAF.

Available Data

Unfortunately, industry literature on risk adjustment is very limited. The only data, outside of the unique knowledge of particular companies or firms, that is readily available is the SPEE Survey of Parameters. Part of the data collected and reported by the survey pertains to risk adjustment. According to the survey published in June, 2002[(2)] average Reserve Adjustment Factors used for acquisitions, as reproduced below in Table 1, range from 96.53% for PDP reserves to 6.52% for Possible Undeveloped reserves. That is, some evaluators apply risk adjustment even to PDP production. The Median Values are somewhat different and reflect the perception that PDP reserves are (relatively) 100% certain.

The term "Reserve Adjustment" may be a mis-nomer since the adjustment is actually to the production projection, but it is clear that the primary criteria for adjustment is the reserve class of the production. A judgement has already been made as to the quality and quantity of available data and the reserves class is assigned accordingly. While the term "Reserve Adjustment" is used, only 44% of respondents apply the adjustment factor to Reserves; the other 56% apply the adjustment to the Discounted Cashflow (DCF).

There are a couple of aspects of the Table 1 that bear thoughtful consideration. The table includes Mean and Median values of RAF for all subdivisions of Proved and Unproved reserves. As might be expected, both the Mean and Median RAF's increase as the apparent risk of the reserves class increases. While PDP reserves are adjusted to 96.53% (reduced by 3.47%), Probable reserves are adjusted by 23.80% and Possible to 6.52%. That is, on average, a Probable barrel of oil is risk adjusted to 0.238 Bbls of PDP oil while a Possible barrel is less than 1/10th of a PDP barrel. Also, the standard deviation of reported RAF for each reserve class can be quite broad. Even among Proved classifications, Proved Undeveloped has a Standard Deviation that spans ± 20.31 percentage points (78.67% through 38.05%). An objective consideration of the data reported by SPEE indicates that there does not appear to be a consensus view on the appropriate value of a Reserve Adjustment Factor for the various classes of reserves. Prior year surveys show similar results.

The SPEE does not suggest that the RAF's reported in the survey are a standard or an accepted industry source for selection of RAF's for evaluation purposes. The survey is a carefully analyzed collection of opinions from knowledgeable persons. The survey is, without question, a valuable and unique source of information-but the survey is not a standard. As noted above, other industry sources are few and far between and many simple refer back to the SPEE Survey. Perhaps, in time, a consensus view of RAF's may develop but for now the subject of risk, particularly as a function of reserves class, is much more a subjective rather than an objective exercise, therefore an attempt to define standard RAF's for use in market valuation would produce an entirely arbitrary result.

Table 1

	Mean (Average)	Median	Standard Deviation
Proved (Developed) Producing	96.53	100.00	5.62
Proved Shut In	82.64	85.00	13.59
Proved Behind Pipe	74.32	75.00	15.89
Proved Undeveloped	58.36	50.00	20.31
Probable Producing	34.25	34.00	24.60
Probable Behind Pipe	29.40	30.00	20.78
Probable Undeveloped	23.80	20.00	19.49
Possible Producing	8.83	0.00	11.60
Possible Behind Pipe	8.10	5.00	10.04
Possible Undeveloped	6.52	0.00	9.24

Are all Risk Adjustments Created Equal?

The information presented in the SPEE Survey of Parameters provides the basis for an interesting analysis of the application of RAF's to evaluations. As noted above, 44% of survey respondents apply RAF to the reserve volumes (production projection) before calculating the cash flow; the other 56% apply the RAF to the discounted cash flow. The data in Table 1 does not distinguish between RAF's applied to reserves as opposed to those applied to the DCF. There is only so much data that can be squeezed out of a survey. But just for the purpose of discussion, let us assume that I have an evaluation of a property where the entire reserve volume is classed as PUD. I have decided that I want to employ risk adjustment in some form but cannot decide whether to adjust the production or the DCF. I have a production projection and an estimate of future steam injection, a reasonably informed guess at oil prices, and good operating cost data which, when put together, result in a cashflow that runs for 11 years starting in 2003. My cost-of-capital plus return-of-investment (discount rate) is 19% BFIT. In this evaluation, the unadjusted production projection totals 1,888,528 Bbls and the unadjusted DCF at 19% totals $10,037,315.

What happens to the value if I apply the PUD risk adjustment from the SPEE Survey to the production projection? Using a 58.36% RAF reduces the future production to 1,102,145 Bbls, which when translated through the evaluation reduces the DCF at 19% to $4,527,586. Part of the reduction in value stems from the fact that the risk adjusted production renders the last 3 years uneconomic resulting in negative DCF for 3 years. On the other hand, if I leave the production projection alone and apply the 58.36% RAF to the discounted cash flow, the DCF at 19% drops to $5,857,777. The property remains economic for 11 years; cash flow in the last 3 years is positive. The differing applications of RAF result in a significant value discrepancy of $1,330,191. Now, for $1,330,191 and a one-year membership in the Evaluator-of-the-Month Club - which value is correct? Of course, that would depend on what "correct" means, but you can see some of the ramifications of the selection and application of RAF's. If Bert and Ernie use my cashflow to estimate a value for acquisition but Bert adjusts the production while Ernie adjusts the DCF, Ernie is going to be the winner and the seller will go merrily off to the bank $1.33 million richer than if both bidders had risk adjusted only the production

Returning to Table 1, the standard deviation shown for the PUD adjustment factor is 20.31% so that the range for over two-thirds of the reported RAF's is from 38.05% up to 78.67%. It is entirely possible that survey respondents who adjust production reported a different range of RAF's than did respondents who adjust DCF so that both sets of factors would

be contained in the average RAF. Taking that one step farther, one could surmise that the RAF's for those who adjust production could be above 58.36% while the RAF's for DCF adjusters are less than 58.36%. If that were so, then Bert and Ernie could end up at the same risk adjusted value.

"Reasonable Certainty"

The relation of risk adjustment factors to reserves class in the SPEE survey is interesting since the relation suggests that the "risk" being adjusted relates to the Quantity and Quality of information available as the foundation for the evaluation. Reserve classes, as we know, are defined primarily by the "analysis of geological and engineering data" where the volumes must be estimated "...with reasonable certainty..." to be considered Proved. Absent other criteria for RAF's, it would appear that the risk being adjusted is the ability to estimate the reserves, production stream, and DCF given the available "geological and engineering data."

This is a good time in our discussion to contemplate another issue regarding RAF. The purpose of the RAF is to compensate a production/income projection for the perceived risk and/or potential error in the projection and to allow the "risk-adjusted" projection to be compared to other projections on either a discounted or un-discounted basis. It is critical to remember that, as with all probability analysis, use of the RAF does not remove the underlying risk or potential error. Risk Adjustment simply attempts to quantify the perceived risk and, assuming the estimate of risk is correct, allow comparison of the expected return of a project to the expected returns from other projects. The lack of data, or poor quality of data, or uncertainty in the data analysis which caused the RAF to be selected in the first place remains and the property will perform as expected or not. Put another way, if the data available and the analysis of that data indicate that the Proved Undeveloped or Probable reserves were X Bbls, the application of a 58.36% RAF does not change the classification of those reserves to a lower risk class; they do not become PDP reserves. It simply means that the value of the income stream to be received from the X Bbls of PUD reserves can be compared to the value of the income stream of X Bbls of PDP reserves - always assuming that the evaluator has guessed correctly on the Risk Adjustment Factor. After all, if RAF's converted Unproved reserves to Proved reserves why would an operator ever report Unproved reserves?

(1) Adam Smith, "An Inquiry into the Nature and Causes of The Wealth of Nations," Modern Library Edition, 1994, Random House, New York, New York, pg. 388

(2) "Survey of Economic Parameters Used in Property Evaluation," Society of Petroleum Evaluation Engineers, June, 2002 Houston TX., pg. 23.

Publications

"Reserves Definitions and Evaluation Practices and Procedures," Canadian Oil and Gas Evaluation Handbook, Volume 1. June, 2002. Calgary, Alberta, Canada. Published by the Calgary Chapter of the Society of Petroleum Evaluation Engineers (SPEE) and the Petroleum Society of the Canadian Institute of Mining, Metallurgy, and Petroleum (CIM). The Calgary Chapter of SPEE is to be congratulated for working together with CIM to produce the Handbook in the relatively short space of 2-3 years from 1998-99 to publication in 2002.

The Handbook has been prepared to provide engineers working in Canada with a set of standards for the preparation of evaluations of oil and gas property. The stimulus for the standards was a decision taken in 1998 by the Alberta Securities Commission (ASC) and the Canadian Securities Administrations (CSA) to create a task force to recommend changes in the reporting requirements of Canadian public oil and gas companies. Part of the work of the task force was to determine if the CIM reserves definitions should be adopted.

"The intent of the Handbook is to establish standards to be used within the Canadian oil and gas industry in evaluating oil and gas reserves and resources. Documentation of these standards in part of that effort... to ensure consistency in the application of evaluation procedures and in reserves reporting."

The determination by ASC and CSA that (1) standards for the estimation of reserves for Public reporting, and (2) that industry engineers should be entrusted to write those standards, is significant and worthy of notice. If the SEC, for instance, were to decide that standards for evaluation of reserves for public reporting were needed, who do you think would be chosen to write the standards?

While the nature of the Handbook as a guide for evaluations done for Canadian securities purposes requires that some of the text be given over to subjects such as Qualifications of Evaluators, Business Practices in Canada, and the Content of Evaluation Reports, this is not, and should not be, a distraction. In fact, some of this information could stand to be reprinted in other publications. As noted in the Introduction: *"The value of an oil and gas asset is a function of the ability or potential ability of that asset to generate future net revenue, and it is measured using a set of forward looking assumptions regarding reserves, production, prices and costs. Capital investment is required to create an income-generating oil and gas asset; however, capital invested in an oil and gas asset does not necessarily indicate the value of that asset."*

The bulk of the Handbook provides a succinct yet highly useable discussion of topics such as:

- **Comparison of Reserve Definitions**. This section presents a very useful and usable side-by-side comparison of the CIM, SPE/WPC, U.S. SEC and Canadian NP 2-B definitions of reserves and brief discussion of the differences. The Handbook suggests that *"...The focus should be on evaluating proved + probable reserves because this sum approximates 'expected' quantities in the statistical sense."*

- **Evaluation Procedures**. This section has two very useful parts, under the heading (7.4), of Product Prices which deal with (a) sources of product prices and price adjustment and (b) the application of financial hedges in an evaluation.

- **Present Value and Profitability**

- **Uncertainty in Reserves** Section 9 contains a short, 16 page discussion of the treatment of uncertainty in reserves estimate including a basic introduction to statistical methods.

Volume I it is a valuable addition to petroleum property literature, particularly in combination with CIM Monograph I which is reviewed below. The Handbook is available from the Petroleum Society online at www.Petsoc.org or by calling the Petroleum Society at (403) 237-5112. The price is C$150.00

***"Determination of Oil and Gas Reserves,"* Petroleum Society Monograph Number 1,** Canadian Institute of Mining, Metallurgy and Petroleum, 1994.

This is not a new publication. It came out in 1994. I have had a copy that has seen hard service for several years but for some reason we had not published a review. The arrival of the Handbook prompted me to remedy that oversight.

There are, of course, any number of books and anthologies of papers available about estimation of reserves so it is difficult to say that any one of them brings a unique perspective to the table. Monograph 1 is no different in that respect - it brings all the usual suspects to the discussion: Reserves Definitions, Volumes in Place, Material Balance, Depletion Mechanisms, Decline Curves, and Recovery Factors, along with chapters on cashflow analysis and product/financial markets. The information is presented succinctly and efficiently, the text is well organized, and the graphs and tables are very easy to read (important as one moves along) all of which aids in both understanding and application.

Certain subjects are covered better in this volume than in any other text that I have used. Chapter 22 deals with Uncertainty and Risk and contains one of the best short presentations of this complex subject that I have read: *"Much of the data used in reserve valuation is obtained in quantitative form (e.g., well log data, production), and a wide variety of statistical techniques can be used for the assessment of the data. Although objective quantitative approaches should be used as much as possible, there will always be a major subjective component to any assessment. For data not available directly, and especially for geological parameters, analogy is particularly important. The selection of appropriate analogs is a critical element of the skill of a professional involved in a reserve valuation."*

"Time limitations mean that, despite the availability of more rigorous methods, most oil and gas volumes are classified as proved, probable and possible using a predominantly subjective empirical approach." ..."When empirical methods are used, the probability associated with their recovery is, at best, poorly known. As an example, it is common to visually fit a straight line to the pressure decline in a gas reservoir, and extrapolate it to an abandonment pressure in order to determine the reserves. The value obtained in this way is usually called proved but, if quantified, it is often claimed to represent a 80 percentage probability level (i.e., there is a 80 percent probability that a greater volume will be recovered). However, by definition, a best-fit, straight-line extrapolation will yield a value close to the mean (usually near a 50 percent probability level). This is a substantial inconsistency that is probably present in many, if not most, gas reserve estimates. Similar inconsistencies occur for other empirical approaches used for both oil and gas reserves evaluation." and further:

"A subjective estimate is essentially the opinion of the person making the estimate. Although it depends ultimately on this person's expertise and objectivity, some measures can be taken to improve the quality of a subjective estimate."

"Qualitative expressions such as "good chance" of, "low risk," "very unlikely," or "probable" may be adequate for everyday use, but the lack of a common standard means that they are of limited use for describing uncertainties in reserves estimation."

The above is coupled with a real rarity; a lucid explanation of the Deterministic/Probabilistic issue which is right up front on page 10, not stuck way in the back of the book. Monograph 1 would be a good addition to any evaluation engineer's working library and clarify, Like the Handbook, Monograph 1 is available from the Petroleum Society.

Courtroom Update

Loyal readers may recall that in our December, 2002 issue there was extended discussion of a significant property tax case here in California that has potential long-term ramifications for petroleum property evaluation in general. In *Maples v. Kern County Assessment Appeals Board*, the

California Fifth District Court of Appeal handed down a decision which, in summary, based on who knows what, and depending on how one holds it up to the light, said that if "risk adjustments" are used as part of a market valuation, then the heretofore Unproved reserves magically become Proved. It is actually a bit more complex than that and readers are referred to the December, 2002 newsletter for a more complete discussion. The important thing to note is that California tax law along with previous court rulings, state regulations and tax manuals, and generally accepted practice only considered Proved reserves as the source of value for property tax.

When we left this issue in December the legal activity had gotten fast and furious. The court's decision attracted a lot of attention not only because of the potential effect on property taxes for companies operating in California but also because of the convoluted rationale used to get to the decision. Occidental, as the real party being affected, filed a petition for rehearing strictly on the Proved/Unproved issue. The court, however, did not want to be burdened with a factual discussion on the topic and refused to grant the rehearing. That left only the California Supreme Court which rarely takes civil let alone tax cases. With undaunted determination Oxy trudged up the hill supported by a pile of amicus (friend of the court) briefs submitted by a Who's Who of the industry including API, and WSPA and SPEE along with a number of the former state tax officials who had written and/or interpreted the law for years. All to no avail-the Supreme Court refused to hear the appeal.

So where, you might ask, does that leave things? Depends on who you ask and how you ask it. Occidental, of course, has to repay the tax payment it thought it got back when they won the appeal the first time at the local level. But since the decision came down after tax assessments had been sent out for 2003, the impact on existing properties with Unproven reserves is uncertain.

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