



SPE 110066

Case Studies Illustrating the Use of Reservoir Simulation Results in the Reserves Estimation Process

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This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

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Abstract

Continuous improvements in reservoir simulation software and the availability of high performance computing equipment are making the use of simulation models commonplace for field development and planning purposes. Naturally, this trend has also increased interest in the use of reservoir simulation model results in the oil and gas reserves estimation process.

As simulation specialists who work in a primarily reserves-evaluation company, the authors are routinely asked to evaluate, and in many cases incorporate, simulation results in the reserves estimation process. In addition, the authors are required to opine on the approach and tactics used by clients while they incorporate numerical models in their reserves bookings. Since there exists limited published discussion on this topic, the purpose of this paper is to provide some examples of the approach used by the authors. We believe this approach to be appropriate and within the spirit of reserves interpretation as used by typical reserves regulatory bodies such as the U.S. Securities and Exchange Commission (SEC).

Papers previously published have discussed the use of models in the reserves process, including the evaluation of the models' themselves^{1,2}. In contrast, this paper provides three case studies that illustrate how results from various models have been used to assist in quantifying reserves. Two of the examples are based on history matched models while the third focuses on a pre-production reservoir where no adequate history is available and probabilistic methods were incorporated to help understand the uncertainty in the forecasts.

While there is no “cookbook” or step-by-step procedure for using simulation results to estimate reserves, the case studies presented in this paper are intended to both show some examples and also spark some debate and discussion. Undoubtedly there will be some disagreement with our techniques, but an open discussion should prove to be beneficial for both reserves evaluators and simulation specialists.

Introduction

The volumes of reserves and the estimated future income attributable to those reserves remains a fundamental tool used for the valuation of an oil and gas project or an entire company. Scrutiny by regulatory bodies such as the U.S. Securities and Exchange Commission (SEC), in the area of reserves compliance has increased during the past few years along with their powers of enforcement through the implementation of the Sarbanes-Oxley act. As a consequence, oil and gas companies affiliated with the U.S. and other major stock exchanges have devoted a large amount of time and effort in reviewing their existing reserves and also the process utilized in the booking of reserves.

The authors of this paper are employed in a company which is primarily involved with reserves evaluation work. The examples presented in this paper are intended to demonstrate the applications of model adjustments from the perspective of simulation experts who are routinely asked to modify such third party models for reserves compliance.

One additional but perhaps very significant item is worth noting. The process for estimating reserves is inherently uncertain. Unless we have a special (magical) machine that can take a snapshot and decisively indicate how much oil is in a particular reservoir, volumetric estimates will always be only estimates. Even if we were to know exactly how much is in the ground, the determination of how much is recoverable is also only an estimate. These statements are not made to belittle the importance of reserves estimates. We are all intimately familiar with their importance; rather, we are trying to place the results of our collective work into perspective. This is why, in the authors opinion, the SEC continues to enforce some controversial requirements, such as year end pricing. It would appear that the SEC is more concerned with the ability for the investing community (individuals or