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The State of Optimum Value Testing - The Vision and the Reality

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Abstract

Since the turn of the century, Shell has had a vision that Optimal Value Testing (OVT) will replace conventional drill stem tests for in-situ measurement of dynamic reservoir properties such as permeability and drainage volume. The term OVT refers to as any testing method that yields fit-for-purpose results at the lowest cost and HSE impact. In more pragmatic terms, an OVT is any pressure transient test in which live hydrocarbons do not have to be produced directly to surface. Currently, we have three types of well tests in our OVT toolbox - wireline formation testing (WFT), closed system testing with cleanup and repeat surges, and injection testing. Our recent examples of closed system tests and wireline formation tests have convinced us that we can get comparable data quality to a conventional test. Injection testing, aimed at determining drainage volume, is still relatively immature, as we have executed only one injection test to date. However, there has been considerable design work that makes us believe that this technology is also promising.

Our experiences with OVT over the past few years suggest that the wireline formation tester solution is the best answer in a large proportion of our cases. We will therefore focus in this paper on describing its strengths, weaknesses, and opportunities. Our applications of this technology are still evolving, and there are clearly more issues to resolve than with a conventional drill stem test. However, by drawing on our increasing breadth of experience, future value of information decisions about doing in-situ dynamic measurements will more often include this cheaper, safer, and more environmentally friendly option.

Introduction

The focus of this paper is dynamic well testing as implemented in exploration and appraisal wells. The industry has continued to use the term “drill stem testing” (DST) to refer to these types of tests despite the fact that many modern exploratory and appraisal tests use a dedicated production string rather than a drill string. Following industry convention, however, we will be using the words drill stem test and conventional test interchangeably throughout this paper. This type of testing in which we flow the hydrocarbons directly to surface while measuring the rate and the pressure is one of the major tools petroleum engineers have used to decide how best to develop hydrocarbon resources. Even under the best scenarios, however, drill stem tests tie up expensive equipment for many days (or weeks) and are a major source of safety and environmental risks such as flaring of the produced hydrocarbon gases. In our organization, cost and HSE concerns have driven us to seek better ways to obtain similar reservoir and fluid data. We have coined the term Optimal Value Testing (OVT) and defined it as any fit-for-purpose well test with minimal cost and HSE impact. In an ideal world, all tests should be optimal, but in our usage, the phrase has come to mean any test in which no significant volume of live hydrocarbons is produced to the surface. We have identified three types of tests that would qualify as an OVT – wireline formation tests, closed system tests, and injection tests.

We will discuss each of these three types of OVT in some detail later, but the first and most important step in evaluating the usefulness of any OVT is to understand why we perform well tests in the first place. The concept of the Value of Information (VOI) is well known within modern Decision Analysis and has been thoroughly described by Newendorp (1975) and Dunn (1992). Simply saying that we need to evaluate VOI to decide how to develop a hydrocarbon resource may sound like a tautology, but VOI has a very specific meaning for the decision analyst.

To understand VOI in the context of OVT, it is worthwhile taking one of Dunn’s examples and working through it with some additions specific to our OVT decisions. Suppose a house painter has to decide whether to take his interior or exterior painting equipment. If he takes his interior equipment he will make $200 regardless of the weather, but if he takes the exterior equipment, he will make $1000 unless it rains. If there is a 70% chance of rain, the correct choice from a decision