Testing for Life

Hatem Soliman, President, Testing Services, Schlumberger

Well testing provides answers you cannot get any other way. Whether testing is performed during exploration and appraisal, development, or production, it provides the greatest levels of security to support decisions—decisions that can affect the reservoir for its active life.

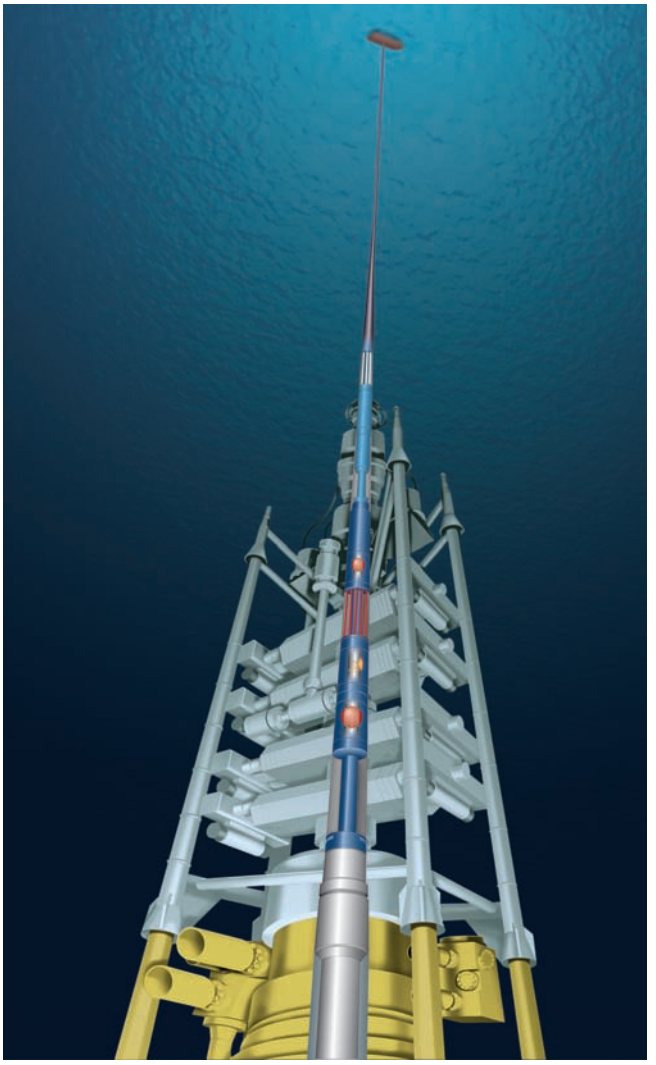
At today's commodity prices, it has become increasingly important to differentiate reservoir description from reservoir characterization. Reservoirs can be described in many excellent and reliable ways: with seismic images, with geologic or petrophysical analyses using well data taken during drilling or logging, or by monitoring production parameters from nearby wells. These methods all tell what the reservoir looks like, but they do not tell how the reservoir will behave over time.

Now, much more than simple reservoir description is possible. Today we can see the big picture, looking deep within the reservoir to get insights about the reservoir fluids and their dynamics. Reservoir characterization is about proving a reservoir's potential, confirming its performance, and improving its productivity. Testing accomplishes this by providing a better basis for all sorts of life-of-reservoir decisions, including how much to invest, where to place additional wells and how to complete them, how to enhance and sustain production, and how to minimize risk.

Reservoir characterization is achieved by combining the best reservoir description parameters with reservoir behavior analysis derived from testing. Today's critical reservoir decisions demand the very best information available—saying "no" to testing is not an option. Testing transcends static well descriptive data by providing insights on what is going on between wells with analysis of pressure and flow under controlled conditions. Testing reacts to formation and fluid heterogeneities that are invisible to seismic and discontinuous between wells or levels. With modern testing analysis, heterogeneities can be characterized and their long-term effects predicted.

Soliman

Hatem Soliman *is President, Testing Services, for Schlumberger, a position he assumed in December 2007. Located in Paris, he directs the global activities of Schlumberger's testing services, including product development programs. Before assuming his current role, he was President and General Manager for Venezuela, Trinidad, and the Caribbean GeoMarket. Before that appointment, he held the position of General Manager for Colombia, Peru, and Ecuador GeoMarket. Soliman began his career at Schlumberger in 1981 working as a logging engineer in Argentina and deepwater offshore Brazil.*



Holding the current world deepwater record, the SenTREE subsea completion test tree keeps wells under redundant control during testing and completion operations.

Testing is Back, With Added Value

The old days of the oilfield, with derricks and pumpjacks sprouting up everywhere, are over. Today, operators strive to drill fewer, but much better, wells. They take great pains to steer wellbores into the highest quality reservoir sections, to understand and exploit each reservoir compartment, and to maximize return on capital. To accomplish this requires accurate and timely information, and testing can provide the critical data to fill the gaps in the dynamic reservoir model. With accurate reservoir characterization, wells can be properly placed, completion intervals and techniques can be optimized, and productivity forecasts and decline curves can be more precise. Surface facilities can be properly scaled and reservoir drainage patterns can be better understood, leading to more effective injection programs.

Deeper fluid insights reveal more valuable reservoir characteristics. Particularly important in deepwater development, flow assurance questions can be resolved from test data so steps can be taken to forestall production interruptions. Experience has shown that produced fluids' characteristics are altered over time as pressures decline or as water cut or gas/oil ratios change. Many of these changes can be simulated in the lab using samples acquired during testing. This has become increasingly important as the industry tackles heavy oil production. The difference between economic success and failure of a heavy oil reservoir can hinge on the proper characterization of the reservoir fluids. When testing is augmented by multiphase flow measurement, multiphase sampling, and pressure/volume/temperature (PVT) analysis, a much clearer picture of in situ production develops. When the stakes are high, and critical decisions are in the balance, testing is the only realistic way to acquire this information.

Drillstem testing used to be standard practice to confirm whether a well would flow or not. Today, it is normal to run tests several times during the development and production phases of a well or reservoir. For example, tests are run to determine the best production rate for the reservoir and to evaluate the efficacy of a workover or a stimulation program.

Testing brings certainty to critical decisions. By creating a "temporary completion" through the test, the operator can see how producing the well affects not only the well being tested, but the entire production unit. Pressure monitors can be deployed in observation wells prior to testing to get a sense of communication between the wells. Enhanced by test data, the dynamic Earth model becomes a proxy for the reservoir, enabling more accurate evaluations, hence more valuable decisions. Since history-matching plays a vital role in understanding the reservoir's reaction to production, every test provides information that will be essential for subsequent production management.

Well testing can take many forms from limited entry closed-chamber tests, to extended well tests using early production facilities. Extended well testing provides a better understanding of the reservoir size and productivity and provides cash flow while a field is being developed. Deploying an early production facility can provide invaluable information that helps operators decide the final design and capacity of their permanent facilities, and keep production flowing while those facilities are being constructed. Whether or not to convert a producer to an injector, or to drill a new injector,

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or to relocate the trajectory of an infill development well are questions that can be resolved using this data.

Intelligent Production

Supporting the timely acquisition of well-test data are new software applications that help reservoir domain experts plan tests and interpret the results. No longer an art, well-test interpretation is a mature science that makes use of multidimensional statistical analyses. Seamless applications bridge the gap between the reservoir and the production facility. Now the effect of any change between the pore and the stock tank can be determined. Accurate decline curve predictions are possible using the new interpretation workflows and programs. These can be used to accurately predict water or gas encroachment and provide evidence to support the prediction. All data can be introduced into a reservoir simulator to predict the result of a decision before a commitment is made.

With dynamic test data, the power of the simulation is enhanced. In addition, because the workflows are linked seamlessly, the results can be introduced into economic programs including discounted cash-flow models that help the operator realize the economic impact of decisions. Hard test data eliminates guesswork that was required previously—decisions are based on measurements, not estimations.

Some of the applications currently addressed by testing include reserves calculations, accurate resolution of complex flow regimes, permanent well and reservoir monitoring, production optimization, production allocation, and dynamic reservoir optimization. At today's commodity prices, and with entire reservoirs being developed by strategically placed wells, the value of testing has grown exponentially. For example, an operator in the North Sea used multiphase well testing to optimize its gas lift, resulting in a 650 BOPD increase in oil production while decreasing gas injection.

The most risky thing about testing is failing to do it when necessary. Management needs to know with an increasing degree of accuracy the value of reserves and the cost of accessing and producing them. As drilling and production risks climb because of deeper wells, deeper waters, heavier oil, corrosive gases, and unconventional reservoirs, operators want to quantify return on capital before they commit. These questions continue for the life of the reservoir.

Testing today is considered a necessity along with seismic exploration, logging, and production monitoring. Test data fills a key gap in the domain expertise needed to understand and characterize reservoirs during their active life, and can be seamlessly integrated into the dynamic reservoir model, to benefit all subsequent decisions. There is no insurance for unpredictable reservoirs, but there is comfort in being as certain as we can be prior to making critical choices. The age-old questions: "Is there oil or gas? How much? What type? Will it produce? For how long? and Where should we drill the next well?" cannot be answered satisfactorily without the information provided by testing. Testing is for life. **JPT**