AAPG Datapages/Search and Discovery Article #90314 ©2017 AAPG Middle East Region GTW, Decision Based Integrated Reservoir Modeling, Muscat, Oman, October 30 – November 1, 2017

From Real-Time Model Update to Simulation Ready Predicative Models

Aus Al Tawil[1]

[1]Saudi Aramco

ABSTRACT

While the well is the means by which the Upstream Petroleum companies generate revenue, optimizing well placement for production and reservoir management purposes will control, if not reduce cost. This abstract lists five factors that affect the success of a well in delivering its objectives:

1. Earth model spatial relationships that determined the geometry of well placement.
2. Integrity of the well that ensures the success of the well in achieving its objectives of production, injection, delineation, disposal…etc.
3. Productivity of the well including production and facility engineering
4. Managing the reservoir short and long-term at the well through contextual field scale performance and dynamic modeling.
5. Safety and environmental objectives

The emphasis in this abstract is on the geoscientific aspects of well planning. To design a well, one needs to get a complete subsurface reservoir image that is both accurate and precise. This reservoir image should encompass all of the geoscience disciplines (stratigraphic, structural, petrophysical, geophysical and their sub-disciplines as well as associated data sets) that undergo multi-disciplinary integration and analysis. These are the basic ingredients to build a 3D numerical model. In reality, it is an exercise of mitigating geological and geophysical uncertainty through an integrated -and- iterative 3D Geological modeling workflow that is founded in first principles and conceptual geoscience knowledge.

For a model to achieve its objectives, it must be a characterization:

1. At the full field scale;
2. That is fully integrated; and
3. That is fully iterative with the well in real time

With this “end-in-mind” understanding, one will have best quantification of hydrocarbon initially in place (HIIP) and, hence, better reserves calculation. Such models emphasize each of the spatial dimensions (1D, 2D and 3D) of the subsurface hydrocarbon reservoirs. They are carried out from the perspective of stratigraphic, structural, petrophysical and geophysical characterization independently and interdependently at the conceptual and semi-quantitative levels. The combination of these discipline-tracks unravel three important aspects of the reservoir: its

geometry, its petrophysical properties and its deformation. The reservoir geometry includes the shape of the reservoir's bounding surfaces and internal layers, the depositional facies bodies' migration trends through space and time, depositional fabric, and diagenesis. The deformation of the reservoir includes structural features such as faults cutting through the reservoir, fracture orientation, trend and density, and dissolution/mineralization. The petrophysical properties must present the possible rages of each property values tied to the petrology within a contextual understanding of the stratal geometry and field scale fractal deformation to deliver a reliable mode of porosity, permeability and water saturation; and their distribution and trends within the reservoir at the field-scale.

The final test of this image is only complete by integration with dynamic data, past and present reservoir performance, which is an image validation through the history matching process. This requires the continuity of static modeling, to dynamic simulation, and through to prediction and optimized prediction. The simulation will not stop until an economical model that includes surface facility is complete. In the heart of this process, one will find that the 3D geological model is the longest-leading subsurface item. Therefore, in the 21st Century, static models need to be constructed only once and must be iteratively and continuously updated, tested and validated in real time as data are generated to always be simulation ready. If we stop at real time iteration between the well and the model, we will fall short of validating field's dynamic performance and simulation. The question on the need or the importance of real time static modeling has to be a thing of the past. Instead, the 21st century paradigm is real time simulation to real time economic modeling for real time sound decisions.