Well Spacing Optimization in Eagle Ford Shale: An Operator’s Experience

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Abstract

A case study is presented as a workflow to identify the optimum well spacing in Eagle Ford Shale. The study incorporates fracture modeling, production history match, and pressure communication observation from offset wells in different areas of the play. The study is integrated with a detailed data analytics overview of nearly 400 wells in the same regions. Stimulation of wells is modeled with sensitivity to different fluid and proppant job sizes. The study results show that there can be justification for staggering of well layout in a particular acreage of Eagle Ford. However, in most of the operated areas fracture modeling predicts fracture growth vertically all through the height of lower Eagle Ford. Simulated fracture growth across the Lower Eagle Ford, along with well spacing previously chosen suggested the wells to be in communication with each other during production. A series of production interference tests, fracturing pressure records and production data analysis indicated that the wells were in communication with each other. Analysis suggested that well spacing can be optimized greatly to increase the overall NPV. Additional fracture modeling studies combined with numerical and analytical reservoir simulation showed that wider well spacing need to be implemented to avoid significant fracture overlap and aggressive production interference when larger stimulations are pumped in the wells. From data analytics also wider well spacing is suggested to enhance the production over the first six-month life of the well. A workflow is finally shown that gives a general overview of the process of finding the optimum well spacing in Eagle Ford Shale.

Introduction

There are nearly 12,000 producing wells exist in Eagle Ford shale in south Texas. Majority of these wells are horizontally drilled from pads that can host several wells in one surface location. In subsurface, the lateral and vertical spacing between a group of these wells along with their performance have become an important measure for field development plans. The well spacing design in unconventional plays such as Eagle Ford relies mainly on two factors: completion design and reservoir deliverability. Fluid and proppant type and volume, injection rate and pressure, cluster (fracture) spacing, and estimated fracture geometry are among the main parameters in completion design for a horizontal well. On the other hand, similar to any conventional well, reservoir pressure, permeability, porosity, hydrocarbon saturation, and Condensate-Gas Ratio (CGR)/Oil-Gas Ratio (OGR) and PVT data are the critical parameters to measure reservoir deliverability of an unconventional well. Well performance analysis in unconventional reservoirs essentially is the practice of evaluating the link between these two main factors for a particular set of wells or for a stand alone well. There are several tools to diagnose and understand this link and formulate it for future wells and pads. Fracture modeling, decline curve analysis, analytical and numerical modeling and pressure interference diagnostics are among the test that are carried out and explained in this study. Recently, there has been several attempts in optimizing well spacing and completion designs for Unconventionals with focus on economics (Lalehrokh and Bouma, 2014; Belyadi et al., 2016) and integration of diagnostic tools (Cipolla, 2015;