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Automatic Surveillance System for Large Gas Fields With Multifrequency Measurements

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Abstract

This paper presents the results of an automatic surveillance system implemented by PEMEX for one of Mexico's largest gas fields. Activo Integral Burgos (AIB) is a typical example of large gas field where production declined due to gas-loading backpressure and reduced permeability in the target formation. The fast decline of the gas wells during their first year of production drove a change from reactive into proactive management tactic to monitor the field and to select candidates for workovers. However, the large number of wells in AIB (approximately 2000 active wells) and the fact 95% of data is manually captured made the implementation of automatic surveillance particularly challenging.

We introduced an automatic surveillance solution that synchronizes the data collected daily in more than 200 wells. Conventional production tools, including Nodal modeling, Turner's equation, Decline Curve Analysis, or Pressure Survey, were individually validated and subsequently implemented as a sequence of automated routines to process the data over the entire field. The data was then analyzed using a self-organizing-map engine to automatically identify wells where fluid loading impedes production. Daily production rates were also computed using nodal models automatically updated with operational data for each well.

The integration of tasks including production data gathering and standardization, monitoring, reporting and alarm functionality, was a key element for the successful and efficient management of gas-loading problems at the field scale. Milestones achieved with this implementation included the automatic identification of problematic wells and a reconciliation of the production rates measured at the gathering stations with rates calculated at the well level.

This surveillance methodology offers new perspectives for the proactive management of wellbore liquid-loading problems in large fields with very limited data stream. The early-stage diagnosis of problems enables the operator to make decisions in record turn-around times and extends the productive life of the wells beyond initial expectations.

Introduction

Major oil companies are promoting new technologies that permit standardization of workflows (or methodologies) for monitoring and optimization of oil and gas production which are hereby referenced as "engineering workflows." They target solutions that help increasing asset recovery factors and knowledge capture by transforming data into decisions at the right time. Examples of application in offshore assets have been abundantly described in the last five years. Most of them involve high frequency data streams provided by smart completions that involve large investments and an early vision of the automatic production surveillance system for the entire asset life. In onshore brown fields, however, the implementation of automatic engineering workflows remains challenging given the lack of high frequency production data or connectivity.

This paper demonstrates that new workflows allow the management of sparse multi-frequency data streams in cases as extreme as those where data is input manually in mature assets. We illustrate this achievement with the example of Activo Integral Burgos (AIB), the oldest and largest onshore gas-producing basin in Mexico, where workflows were implemented for automatic surveillance and optimization of gas production. The implementation at AIB was divided into three successive phases. The first phase includes an assessment of the existing data workflow for operation and surveillance process, and a standardization effort for the varied existing data acquisition formats. The second phase and core of this paper deals with a 210-well pilot design and implementation of engineering workflows targeting the early identification of production loss by liquid loading and reduction of permeability in target formation. The third phase consists of expanding the second phase to 1190 wells, which is currently under process with a completion target of December 2007. Figure 1 shows the growth curve of the number of wells included in the project through time.

In this paper, we briefly review the background for the AIB project before analyzing the main three automatic workflows used in AIB and drawing best-practice lessons for large onshore gas field implementations; we then describe the results obtained during production monitoring and underline the benefits of such an implementation.