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Sand-Face Completion for a Shallow Laminated Gas Pay with High Fines Content

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Abstract

The Shallow Clastics Field operated by Sarawak Shell primarily targets 2 shallow gas-bearing reservoirs, H1 and H2 at approximately 2,650 ft true vertical depth. An appraisal/early-producer well was drilled with a deviated wellbore through the H1, H2 targets, and a completion design consisting of a cased and perforated co-mingled completion inside 9-5/8-in. casing was implemented. The sand-face completion design consisted of a large-OD expandable sand screen with 150 micron weave opening across the 2 zones. Upon completion, the reservoirs were cleaned up through a temporary well clean-up and test facility to test productivity and evaluate integrity of the downhole sand-exclusion installation. Fines production, possibly due to a failure of the expandable screens, steadily increased to the extent that the well was deemed un-producible to the facilities.

A re-evaluation of the sand exclusion method that included more extensive core analysis and the types of wells that would be suitable for development of the H1/H2 reservoirs was initiated. From this review, the operator and a service/ engineering company were able to develop an innovative sand-exclusion method that combined several new technologies.

To date, 4 wells have been completed with the new sand-exclusion method and the well configuration chosen to address completion needs. These have been tested, and to date, have proven to be operating satisfactorily. This paper will review the evaluation that led to the sand-face completion design, the field implementation of the design, and the key installation success factors that were required. Results and a summary of best practices from the initial installations will also be summarized.

Introduction

Sarawak Shell's Shallow Clastics field consists primarily of 2 shallow gas-bearing reservoirs, H1 and H2, at approximately 2,650 ft TVD. These reservoirs are laterally extensive, covering an area of 200 sq km with an estimated gas in place (GIP) in excess of 2 Tscf. The reservoirs are made up of a sequence of highly laminated sand and shale deposits with significant sand-size variability and high fines content. Being highly unconsolidated, downhole sand exclusion is mandatory. The primary drive mechanism is a depletion drive based on the weak aquifers seen in existing fields in the area. The Shallow Clastics reservoirs overlay deeper Central Luconia carbonate gas reservoirs, which are already on production with further fields in development; therefore, a gas processing and gathering system was already in place. Gas from all of the fields is produced to the Malaysian Liquified Natural Gas (MLNG) plants at Bintulu, East Malaysia. Production from Shallow Clastics is intended to counteract decline from other fields and is critical to maintaining the security of the supply to MLNG.

Significant log data (Fig. 1) on Shallow Clastics were gathered from the appraisal and development wells of the deeper carbonate gas reservoirs; however, core data were limited to what could be generated from a single, poor-quality core from E11-SC1. A dedicated Shallow Clastics appraisal/ early-producer well (E11-SC2) had been drilled with a deviated wellbore through the H1, H2 targets, and a completion design consisting of a cased and perforated commingled completion inside 9-5/8-in. casing had been implemented. The sand-face completion design consisted of a large-OD expandable sand screen with 150 micron weave opening across the 2 zones. Upon completion, the reservoirs were cleaned up through a temporary well clean-up and test facility to test productivity and evaluate integrity of the downhole sand-exclusion installation. Fines production, possibly due to a failure of the expandable screen, steadily increased to the extent that the well could no longer be produced.

Initial Well Design and Sand-Control Challenges

The field development plan for Shallow Clastics called for phased multi-well development from 4 locations that would include the existing carbonate development, E11, and the future F13 drilling platforms. Given the existing infrastructure, it was logical to tie production from Shallow Clastics back to the processing system at E11. This plan would require a dedicated booster compressor for Shallow Clastics because of the lower reservoir pressure compared to that of the deeper carbonates.