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CBM: Fracture Stimulation—An Australian Experience

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Abstract

This paper reviews the fracture stimulation experience at the Dawson Valley CBM project situated in the Bowen Basin, Queensland, Australia. Multi stage water fracture stimulation was proven to be the most effective stimulation method. Stimulating multi-seam targets requires an aggressive fracture technique to ensure more than one seam is stimulated. Water volume, rather than sand volume, influences the Fracture Stimulation effectiveness.

Geological Setting

The Bowen Basin is a Permo-Triassic basin approximately 900 km long and 300km across at its widest point. The Dawson Valley project (Figure 1), located on the eastern boundary of the basin was deformed during a Triassic compressive event which caused extensive over thrusting from the east. This CBM project targeted high volatile bituminous coal seams of the Baralaba Coal Measures; in which there are up to 10 coal seams (Figure 2), some as thick as 4m, with an aggregate thickness of 25m and depths ranging from 250m to 1000m. Gas contents range from 8m3/t to 16 m3/t. The coal seams outcrop at an open cut coal mine and dip 3 to 8 degrees to the west and have low permeability. The dip of the coal seams led to surface to inseam techniques being applied in the shallower sections (ie to approximately 500m depth) and fracture stimulation in the deeper sections (i.e. from approximately 350m to 800m depth)

Project Background

The Dawson Valley project is located in petroleum lease 94 (PL94). Commercial production commenced November 1996. The project comprises four separate fields; (Dawson River, Nipan, Moura and Mungi).

Though an extensive resource, identifying areas of commercial flow rates, in the deeper section, has proved challenging. In the deeper section the average production flow was approximately 250 Mscfd and mean reserve was approximately 1 BCF per well on an 80 acre spacing.

The key production deliverability parameters were the geological structure and associated stress setting. Areas of high stress, thrust (reverse) faulting proved unproductive, whereas extensional areas such as half grabens or structural flexures were far more productive. Geological location was determined to be a primary and therefore commercial parameter in determining the effectiveness of the fracture stimulation type or method. The current method of fracture stimulation evolved through a trial and error process in testing a combination of gel, nitrogen foam and water fracture stimulations. Production and laboratory results confirmed that gels had an adverse affect on the coals and nitrogen stimulations had mixed results. Ultimately basic water fracture stimulation proved superior to the other stimulation methods. The focus of this paper is the performance of the water fracture stimulation method.

Completion

Each well comprised of up to 10 seams over a 300m interval. The seams were fracture stimulated in 4 or 5 stages. Coal seams, greater than 1.5m, were chosen to be stimulated. The stages were designed around the thickest seams. Staging was achieved by placing the baffle 3 to 5m below a target seam and 10 to 15m above the lower stage target seam. Ideally, these seams were stimulated individually when ever possible.

To be effective, water fractures require large pumping rates and, to minimise friction loss, the fracs are pumped down the casing. The wells are completed in 5 ½" L80 17# casing and aluminium ball and baffles used to isolate the stages. 5000 HHP pumping equipment, capable of delivering 60 lbs/min slurry, was required. Each stage comprised approximately 60,000 lbs of sand and 2,000 bbls of water.

The bottom most stage was perforated with casing guns and fracture stimulated. Generally, no flow-back post frac occurred and an aluminium ball was launched to isolate the first stage. The next stage was perforated, stimulated and isolated. This sequence continued until the final stage was completed. The well was flowed back to reduce wellhead pressure prior to the completion. A workover rig, utilising an air compressor and hammer bit, was used to drill out the balls and baffles and clean out the well bore prior to running the completion. The well was completed with a PCP pump on 2 3/8" tubing. The well design incorporated a 100m rat hole to