



Drilling & Completions Lessons Learned Along the Way to Duvernay development

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Summary

The journey to commercial development in a new play does not necessarily proceed smoothly apace without speed bumps. XTO will share its journey from early appraisal to commercial development with an emphasis on Drilling and Completions learnings.

XTO's Duvernay acreage in Kaybob South was acquired as part of a corporate acquisition in 2013. Therefore, XTO had no internal history or experience with the play, and the Duvernay was only an emerging play. Early well production results piqued the interest of senior management and eventually led to commercial development which initiated in 2017. During the appraisal period there were several key learnings with respect to drilling and completions operations that will be discussed:

- Casing program evolution and how it tied to the frac design (water and sand intensity)
- Casing failures while fracturing in sour areas. In very early Duvernay wells, it was not well understood where to expect H₂S. There were early well failures as a result of using sweet service materials in an area with moderate H₂S as a result of sulphide stress cracking during a hydraulic fracture. Well design learnings will be discussed.
- External corrosion from the Winterburn group. As part of the acquisition, XTO had several conventional wells that came with the asset. These were deeper wells that penetrated through the Winterburn and produced from the Beaverhill Lake. Many of these wells had external corrosion failures at the Winterburn formation. Duvernay well designs were implemented to accommodate this via either external coating of casing (early wells with liners), or placing intermediate casing below the Winterburn to avoid this formation being in contact with production casing.
- Rotary steerable versus motors. In early commercial development, conventional motors were used to drill the lateral sections (3000m lateral sections). After a few challenging casing runs, rotary steerable technology was trialed in order to evaluate the benefit on casing running and these learnings will be shared. The impact of an RSS drilled lateral on coiled tubing access will also be shared.
- Effect of hole size on casing drag. In acreage delineation, a well design was utilized which allowed a 5.5" production casing to be run inside a slim 6.75" hole. The hole size was minimized because at the current time rigs were not capable of efficiently drilling a larger hole due to inadequate mud pump power. Once rigs were available that had sufficient power, the hole size

was increased to 7-7/8" and then 8-1/2". The effect of this hole size change on casing drag will be shared.

- Effective toe initiation sub activation. During delineation drilling a persistent problem was encountered where toe initiation subs would not reliably open (some would open, and some would not). The consequence of toe ports not opening up would usually be a coiled tubing confirmation run, and tractor deployed perforation guns. The Duvernay requires a heavy, high solids content oil based mud to drill. As wells are drilled longer and longer, the wiping efficiency of standard cementing equipment was not acceptable. Cementing equipment was designed and operational practices were modified which resulted in a 100% success rate in development mode.