

Waskada Unit No. 14

Waterflood Progress Report

January 1st – December 31st, 2013

PennWest

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Introduction:

The Waskada Unit No.14 pressure maintenance project commenced water injection into the Lower Amaranth designed and in accordance with Manitoba Energy and Mines Approval No. PM 58.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 58

Unit Information

UNITIZED ZONE: Lower Amaranth
Original Unit, February 1, 1988 Board Order - Voluntary

POOL: Waskada Lower Amaranth A (03 292A)

This report documents the performance of the Waskada Unit No.14 pressure maintenance project for the period of January 1 to December 31, 2013. The Unit had no production or injection in 2013.

Unit # 14 is part of the main Waskada field. The Waskada field is situated on the northeast rim of the Williston Basin in southern Manitoba. It comprises a large portion of Township 1 and 2, Ranges 25 and 26 W1.

Geology

The Waskada Fields produce light density crude (approximately 36° API), predominantly from the Lower Amaranth formation. This is an interlaminated, shallow marine to subtidal succession of sandstones, siltstones, and shale progressively onlaps the Mississippian unconformity surface from basin center, up dip to the north and eastern basin limits in Saskatchewan and Manitoba. The fine grained reservoir rock has a complex reservoir characterization with 13 to 16 % porosity and permeability on the order of 0.5 to 15 md. The Lower Amaranth, the oldest Mesozoic unit, is a clastic red bed sequence lying directly on the Paleozoic erosional surface. It consists of a series of dolomitic siltstones and sandstones interbedded with argillaceous siltstones and shales. The section is usually subdivided into a lower sandy unit and an overlying shale unit. The lower sequence is the oil production zone. The bulk of pay is found in the laminated sandstone/siltstone facies.

The Lower Amaranth has been classified into four general lithological types:

1. Interbedded shale/siltstone/sandstone by grain size, color and texture
2. Siltstone – This lithology occurs in distinct intervals up to two or three metres in thickness. It is generally light green in color and dolomitic.
3. Laminated sandstone – This occurs in distinct sandy intervals with a wide range of grain sizes and primary sedimentary structures.
4. Massive sandstone – This lithology occurs in thin intervals and usually associated with the laminated sandstones facies. Beds are usually light grey to reddish grey in color and coarse to medium – grained.

Discussion

Production and Injection Performance

Board Order No. PM 58 provided for pressure maintenance operations in Waskada Unit No.14. From the startup of injection in 1988, injection rates fluctuated to the same degree in each injector, making it difficult to link any production responses to any injector. The Unit includes 3 injection wells, none are currently active, and 6 active producers. Pressure maintenance by water injection ceased in February 2000.

Please refer to Attachment 2 – A spreadsheet of the Unit Well List and History.

Please refer to Attachment 3 – A Production and Injection plot of the Unit.

Please refer to Attachment 4 – A spreadsheet of Unit Annual Volumes and Rates.

Please refer to Attachment 5 – A Cumulative Production and Injection plot of the Unit.

Voidage Replacement Ratio Calculation:

The Cumulative VRR from production start reached a maximum of 0.82 in 1997 and has declined in the last 2 years to 0.5. The Cumulative VRR from injection start stabilized at 1.7 and has declined in the last 2 years to 0.7. The decline in both Cumulative VRR's in the last 2 years is coincident with no injection from February 2000, no production from January 2004 and the startup of horizontal producers in 2012. Currently there are no active injector in this Unit and PennWest has no plans to reactivate at this time any of the old injectors.

Please refer to Attachment 6 – A Unit Voidage Replacement Ratio Plot.
Please refer to Attachment 7 – Individual Injection Well Performance Plots.

Pressure Surveys:

No pressure surveys were conducted in 2013.

Corrosion and Scale Prevention Program:

We currently inject ScalCor down all the new horizontal wells. PennWest will be installing cathodic protection on the wells. The new gathering system is Fibreglass and as such is not susceptible to corrosion.

Summary and Recommendations

The behaviour of Waskada Unit 14 producers are indicated by good initial oil productivity, rapidly declining to low decline rates, with almost no discernible water flood response. This behaviour can be explained by drops in the reservoir pressure from initial, approximately 8700 kPa, to above the bubble point, about 4200 kPa, followed by solution gas breakout. It is also believed that fracture stimulation treatments, performed on these wells prior to initiation of water injection, “broke through” into the higher productivity Mississippian and that the majority of injected water to date has entered this zone. This is one of the major explanations for lack of waterflood response to date and the continued decline in oil productivities.

A horizontal producer and conversion of vertical producers to injector well pilot was contemplated for the Lower Amaranth targeting Unit 13 with results scalable to all Lower Amaranth Units. It is currently inactive pending evaluation of alternative schemes.

