Noise, Temperature, RBL & Pulsed Neutron Interpretation

EnCana Oil & Gas (USA) Incorporated
Grenemeyer Wagner #12-34
API #: 05-123-21026
January 26, 2015

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Casing Description	Size (in)	Casing Weight (lb/ft)	Depth Interval (ft)
Surface	8 5/8	24.0	Surface – 1,068
Liner	4 1/2	11.6	Surface – 8,406

Purpose

Determine the movement of gas or fluids in casing annulus

Cementing/Bond Log Information

No cement data available

Noise Temperature Log Interpretation

Logging Interpretation Parameters

Frequencies Recorded:	200 Hz/600 Hz/ 1000 Hz/ 2000 Hz/ 4000 Hz/ 6000 Hz
Bottom Depth Driller:	8,412 ft
Logging Interval:	Surface – 8,200 ftKB
Station Stop Interval:	20 ft (standard)
Recording Times:	± 10 seconds

Note: Audible files are reviewed on a per station-stop basis. This audible review identifies debris strikes, tool movement, and other non-flow related noise that may be present on datasets and may appear as spikes on the printed log. Written review will discount the noise anomalies as such. Frequencies associated with gas movement typically range from 1000 – 4000 Hz (mid-range frequencies). These frequencies and the associated amplitudes are focused on during the review process.

Noise

From 8140 to 7000 ft there is very little noise associated with flow across the interval. There are indications of low frequency (below 1000 Hz) amplitudes at 8140, 8100, 7780, 7660, 7400, 7260 and 7020 ft that are related to surface noise and/or tool movement against casing. From 7000 to 5760 there is an introduction of low frequency consistent background noise that appears to be mechanical in nature (consistent noise frequency response and timing). At 6220 and 6120 ft audible files suggest that there is debris contacting the tool. From 5740 to 3880 ft there is an indication of movement behind casing as indicated by the increase in noise amplitude across higher frequencies (above 1000 Hz). From 3880 to 3160 ft there is an indication of distant noise in the audible files which appears to be originating from below (+/- 5460 ft) transmitting up the wellbore. Above 3160 ft there is no indication of movement within or behind casing which is indicated by a lack of noise amplitude above 600 Hz. At 2840 ft a strong mechanical noise begins and continues throughout logging until 200 ft. Due to the consistent and low frequency mechanical nature of this noise it is not interpreted as fluid or gas movement. Likely it is an artifact of the offset pumping oil well or transmission of Surface noise from the on-site facilities.

Based on the noise response above 3160 ft in can be inferred that there is no indication of fluid or gas movement in the annulus. Cement top is indicated around 4160 ft, above this point any fluid or gas movement in the annulus should be detected by the noise tool as the flow path is clear and gas volumes increase proportionally with depth (as hydrostatic pressure is reduced – ideal gas law) and therefore noise amplitude should increase.

Temperature

Temperature profile shows some differential from the gradient throughout the logged interval. Due to the small variability of the temperature, no discernible conclusion may be drawn from its use.

Pulsed Neutron Log Interpretation

There are indications of potential gas zones as indicated by a shaded cut-off of the Sigma Curve across the following intervals: 7815 – 7794 ft, 7678 – 7655 ft, 7593 – 7570 ft and from 7422 – 7397 ft.

There is no clear indication of gas zones above the competent cement top which supports the noise interpretation that indicates that there is no indication of gas or fluid flow above 3160 ft.

Radial Bond Log Interpretation

Cementing Information

No cement details available

Log Evaluation

Interpretation Parameters

Free Pipe Amplitude (0% Bond)	81 mV (chart value)
Free Pipe Travel Time	254 µsec (chart reading)
100 % Bond Amplitude	2 mv (chart value)
USEPA Minimum Isolation Cut-Off	4.7 mV
Hydraulic Isolation	5 foot interval

1) Conventional cement log analysis utilizes USEPA guidelines for determining if cement with an amplitude less than a certain value should be sufficient to provide hydraulic isolation. Using these guidelines, for this well, amplitude of less than 4.7 mV would be sufficient to provide isolation if the bonded interval is 5 feet or longer.

2) A cut-off was applied to the 3' amplitude curve on the main log pass at a value of 4.7 mV to determine areas that meet the USEPA guideline for cement that should provide isolation. Areas that have zonal isolation capabilities are at:

From (ft)	To (ft)
4390	4450
6716	6948
7008	8164

Interval (ft)	Amplitude, TT, VDL	Radial Map, Radial Amp	Cement Comments
Surface – 4162 ft Competent Cement Top: 4162 ft	Amplitude is higher than 4.2 mV, increasing to a maximum of 81 mV. Pipe arrivals and chevrons in the VDL	High radial amplitudes, light shading on the radial map	Free Pipe, annular fluid has little to no compressive strength. Does not meet isolation guidelines
4162 - 4390 ft	Amplitude is higher than 4.2 mV	Higher radial amplitudes, lighter shading on the radial map	Fair quality cement but fails to meet the isolation guidelines. Possibly lower compressive strength
4390 – 4450 ft	Amplitude generally at or lower than 4.2 mV, no pipe arrivals, formation response in VDL	Low radial amplitudes, darker shading on the radial map	Good consistent cement that meets isolation guidelines
4450 – 5728 ft	Amplitude is higher than 4.2 mV	Higher radial amplitudes, lighter shading on the radial map.	Fair quality cement but fails to meet the isolation guidelines. Possibly lower compressive strength
5728 – 6716 ft	Amplitude is higher than 4.2 mV, increasing to a maximum of 81 mV. Pipe arrivals and chevrons in the VDL	High radial amplitudes, light shading on the radial map	Free Pipe, annular fluid has little to no compressive strength. Does not meet isolation guidelines
6716 – 6948 ft	Amplitude generally at or lower than 4.2 mV, no pipe arrivals, formation response in VDL	Low radial amplitudes, darker shading on the radial map	Good consistent cement that meets isolation guidelines
6948 – 7008 ft	Amplitude is higher than 4.2 mV	Higher radial amplitudes, lighter shading on the radial map	Fair quality cement but fails to meet the isolation guidelines. Possibly lower compressive strength
7008 – 8164 ft	Amplitude generally at or lower than 4.2 mV, lack of pipe arrivals, formation response in VDL	Low radial amplitudes, darker shading on the radial map	Good consistent cement that meets isolation guidelines

Interpretation Summary

The absence of high frequency noise energy related to fluid or gas movement above 3800 ft, lack of formation gas indications from Pulsed Neutron logging above 7397 ft and competent cement from 4390 – 4450 ft suggests that there is no annular gas or fluid movement above 3800 ft. Due to the lack of noise above 3800 ft it can be inferred that the movement from 5740 to 3880 ft is due to cross flow as no detectable gas movement is occurring above cement top. All three sensors have individually provided data that suggests no fluid or gas movement in the annulus or wellbore above 3800 ft. In addition, intervals of cement quality above in-situ movement (+/- 5260 ft) appear to be capable of hydraulic isolation based on USEPA standards, further suggesting that gas flow is not occurring above 3800 ft.