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Microseismic Measurements and Results in a Flowing Well During Well Stimulation

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SUMMARY

The measurement of low magnitude microseismic signals is a challenge inside a producing or injecting well with the high amplitude level of flow noise.
We will present a recent deployment of the PS3-FW sensor tool technology for flowing wells and the results from the monitoring of a stimulation operation together with the reservoir understanding derived from it.

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The PS3-FW technology provides coupling of the sensor assembly to the casing by hydraulically de-coupling it from the production tubing. Good cement bonding allows the connection from the sensor to the rock formation, thus the acquisition of reservoir related microseismicity.

A standard PS3-FW deployment is based on a four levels system which can be installed with a separation of a few hundred meters.

The primary objective of this project was to field test the PS3-FW tool with the ability to measure inside a flowing well.
The secondary objective was to monitor any reservoir related microseismic activity in order to obtain useful information about dynamic reservoir behavior.

The limitations of the well design, casing size and liner position did only permit the installation of a two levels system. Those two levels could not be placed at an optimum position, which caused an increased measurement uncertainty and the interpretation of the results. Overcoming or mitigating the effects of those various limitations of the array did require the use of advanced workflows. Despite the limitations, a total of a few hundred microseismic events were detected and the locatable events represent a range of magnitudes from Mw= -1.8 to Mw= 0.6 with distances from 800m to 10km.

The system was designed and deployed as a permanent system. However, difficulties in terms of achieving projected production rates resulted in the early retrieval of the completion and in consequence the early retrieval of the downhole monitoring system. The system was fully retrieved and can be re used in a new well. In total the monitoring program lasted for two months.

During the time of monitoring, the PS3 tool has demonstrated its capabilities in terms of measuring microseismic events even during periods when fluid was being actively pumped down the tubing.