

PRIME Technology conveys integrated production logging solution for water shut-off

AkerBP needed to conduct a production logging operation in a multi zone gravel pack horizontal well completion. The main objective was to diagnose and access the current production profile across the reservoir section to identify the major water inflow zones and design the required water shut-off (WSO) strategy.

The challenge was to determine the independent flow contribution of the multiphase flow expected within the horizontal section of the well, with stratified flow separating the gas and water phases. Furthermore, there was the expectation of possible water flow along the outer side of the gravel pack screens.

As a secondary objective, AkerBP also wanted to evaluate the **OPENFIELD Flow Array Sensing Tool (FAST)** in this environment – a micro electro-mechanical system (MEMS) technology offering a highly compact production logging solution. We were tasked to provide an efficient and effective solution, one which would minimize the number of runs to execute the work scope.

Solution

We recommended using our **Multiple Array Production Suite (MAPS)**, a solution offering a range of production logging tools incorporating multiple sensors designed to enable flow interpretation and quantification in highly deviated multiphase flow well scenarios. Specifically, the **Resistance Array** and **Spinner Array** modules would be run. Added to that would be an in-line spinner, a capacitance temperature tool, pressure and density sensors, and a continuous flowmeter spinner placed bottom-most in the toolstring. Gamma ray and CCL tools were included for depth correlation. All data from these tools would be available in real time enabling in-well data quality checks

and the determination of production stabilization prior to flow pass data acquisition.

To evaluate potential flow behind the screens, we added TGT's acoustic sensing tool (Chorus) to the toolstring. Also included in the same string was the FAST tool, equipped with advanced optical probes for three phase differentiation. Aside from being run for comparison purposes, the FAST tool also provided additional hold-up data.

Whilst the data from these additional tools would be recorded in memory for this specific job, through tool wiring would enable real-time data from the PLT tools positioned below, namely the temperature/capacitance and continuous flow spinner. We used our proprietary **PowerTrac PRIME Tractor** to convey this advanced toolstring over the horizontal section, its slim 2-1/2" OD minimizing flow disturbance during the data acquisition.

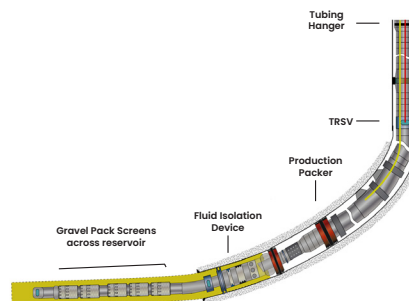
Challenges

- Production logging operation in a multi zone gravel pack horizontal well completion
- Diagnose and access current production profile across the reservoir section to identify major water inflow zones and design cut off
- Determine independent flow contribution of the multiphase flow expected within the horizontal section of the well

Results

- Real-time data enabled rapid interpretation turnaround time and decision making
- Comprehensive technology comparison enabled due to toolstring combinability
- Time and cost savings from seamless multi-tool integration
- Water production reduced to one tenth of what it was prior to the WSO implementation

Gravel pack completion schematic



Result

Following a precautionary drift run incorporating a multi-finger imaging tool, the proposed production logging string was run. Normally only one run in hole would have been necessary, however due to poor weather conditions the operation was aborted after the shut-in pass. Once safe to do so, the operation resumed, the well put on production, and an initial "safety pass" carried out while waiting for flow stabilization.

Initial interpretation was done using the real-time data from the MAPS tools and other PLT sensors in the string, with data files transmitted to our shore-based data analyst for intermediary interpretation. This enabled early confirmation with the client on the well's behaviour and the selection of water shut off depths. Memory data from the Chorus and FAST tools were incorporated once the tools were out the hole, further enriching the final interpretation.

The operation and its interpretation was delivered by our team. Overall data quality was good, flow profiles were consistent, stratified flow was clearly identified, and cross flow between zones was detected. The FAST result was found to be in line with that from the MAPS tool. Due to the absence of logging while tracting capability on this specific operation the FAST tool data was also used for down-pass interpretation. The rich data set enabled a well-informed and confident water shut-off (WSO) strategy to be determined and subsequently executed. As a result of this, the water production has been reduced to one tenth of what it was prior to the WSO implementation.

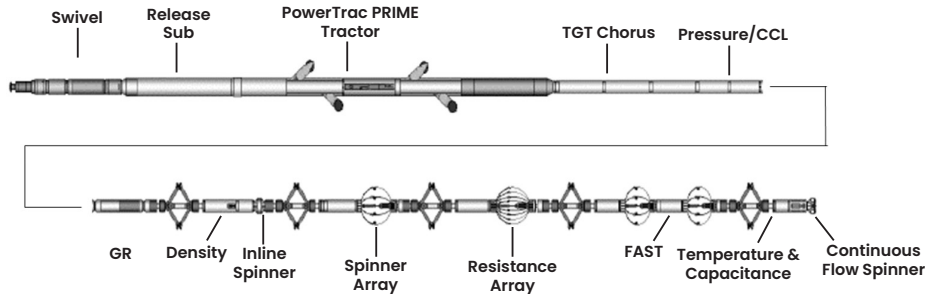
MAPS Spinner Array Tool



FAST v4 Tool



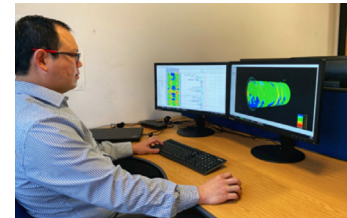
Advanced Production Logging toolstring for horizontal well diagnostics



The full operations team on board the LWI vessel - Island Constructor



Shore-based Data Analyst



Composite log of interpreted production data

