CASE STUDY

EVALUATION OF ICD COMPLETION PERFORMANCE BY CAPACITANCE & HIGH-RESOLUTION TEMPERATURE ARRAY TOOLS & **STREAM™** FOR FURTHER OPTIMIZATION OPPORTUNITIES

Location: Middle East

Well type: ICD completion horizontal oil producer

Average production rate: 383 bpd

Challenge: Inflow Control Devices (ICDs) require high precision in evaluating inflow fluid velocity and phase determination to ensure optimal performance. In wells with horizontal trajectory and high water cut, it is especially important to accurately identify the ICDs associated with oil production to effectively optimize selective production for WSO.

Objectives: detailed performance evaluation of each ICD and construction of the production profile considering segregated flow regime.

Solution: Capacitance & High Precision Temperature Array Tool (CAT & HR TAT) is utilized for 3D fluid phase identification and production profile evaluation by the acquired high-resolution temperature data and T-FLOW technology.
The T-FLOW in combination with the CAT & HRTAT allows the building of a detailed production profile addressing the segregation of the fluid phases across the lateral section of the wellbore.
Additionally, the FIND technology was used to confirm the performance of each ICD as well as to localize the flow intervals behind the ICD liner.

CAT & HR TAT

The Capacitance & High-Resolution Temperature (HRT) Array Tool consists of 6 miniature sensors installed around the circumference of the tool on self-centralized rigid arms facing fluid flow at 45° covering the entire cross-section of the wellbore. Each sensor includes capacitance and high-precision temperature probes (2 in 1).

T-FLOW (Temperature Modeling)

The math solver allows predicting the heat exchange between the wellbore and the reservoir based on hydro/ thermo-dynamic theory. The technology uses a high-resolution temperature data acquired by the High-Resolution Temperature Array Tool as an input. The method provides detailed production profile.

FIND (Flow Identifying Noise Detector)

The new-generation spectral noise logging tool is equipped with highly sensitive hydrophones that detect even small flow-related acoustic events in the wellbore and behind. The split-channel architecture of the tool allows the high-resolution recording of the acoustic signal from each noise domain (low and high) independently with different levels of amplification. It allows the precise localization of the flow intervals behind the casing.

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Results

Based on the Capacitance Array Tool (CAT) data the indication of oil was associated with ICDs 2-5. According to a 3D color map and 360° cross-sections, the oil spots were localized across the top part of the wellbore (refer to the Fig below).
The T-FLOW temperature modeling shows that the majority of the production is related to the cooler fluid flow from behind the logging interval where the CAT data indicates only water.
The FIND tool confirms the contribution of production from each ICD with the most active response from ICD#1 and ICD#3. It is related to the fact that the first three inflow control devices have smaller diameters of ports (nozzles) leading to increased amplitude of the recorded noise in the high-frequency domain.
In addition, two intervals of the flow behind the liner were captured by FIND Channel 2 and static pass temperature curve. The first is between ICD#1 and ICD#2, and the second is below ICD#3. Both intervals terminate in zonal isolation packers, confirming the packers are leak-tight.

Major outcomes

- The major water source was localized by CAT&HR TAT and T-FLOW
- Contribution of all ICDs was confirmed by FIND
- Oil production from ICDs 2-5 was confirmed by CAT
- Sealing of packers was confirmed