

# Devon Energy Minimizes Flowback Completion Damage by Following the Recommended Secure Operating Envelope

AvantGuard services' integration of geomechanical modeling, data analysis, and real-time solids monitoring guides poststimulation operations, Permian Basin

## CHALLENGE

Minimize the risk of uncontrolled sand flowback and near-wellbore fracture pinchout to significantly reduce completion damage in wells in the Permian basin.

## SOLUTION

Employ AvantGuard\* advanced flowback services to preserve the connection established between the hydraulic fractures and the wellbore by

- conducting comprehensive data analysis and geomechanical modeling to establish a secure operating envelope (SOE)
- continuously monitoring flowback operations in real time, including solids production, to calibrate the SOE and confirm performance.

## RESULTS

- Identified an SOE that translated to an optimal choke management strategy.
- Addressed loss of fracture connection caused by development of an unpropped area and fracture pinchout near the wellbore.
- Optimized well operations in real time.
- Calibrated and fine-tuned the geomechanical models for guiding poststimulation operations on subsequent wells.



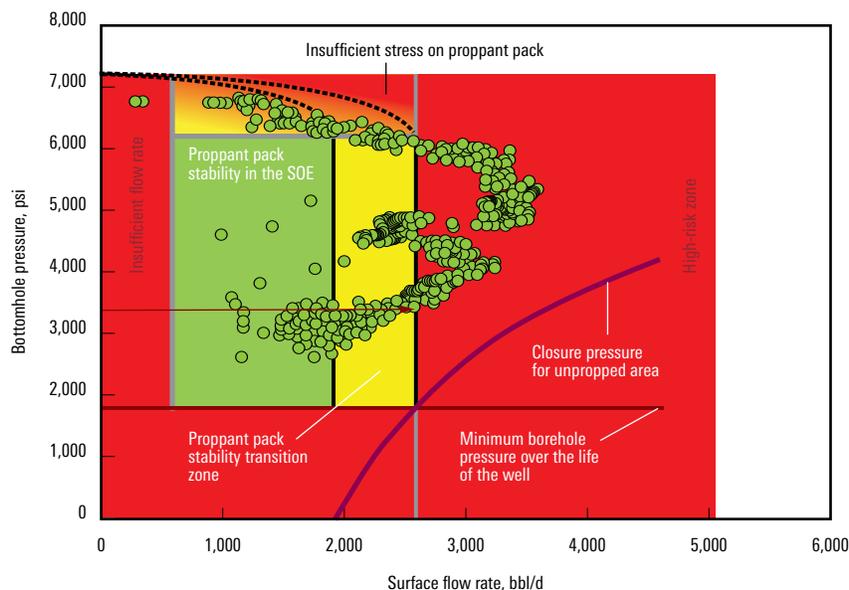
## Optimize flowback operations and production in an unconventional reservoir

An important stage between the end of fracture treatment and the beginning of production is the flowback period. It usually involves high rates of drawdown imposed on the well to accelerate fracture fluid unloading, sand cleanup, and hydrocarbon production. If the flowback operation is not properly performed—taking into account rock and fluid properties—damage can be done to the formation, the fractures, or both. In this context, excessive proppant flowback from fractures presents a significant concern because it usually results in the creation of unpropped areas in the near-wellbore zone, which can easily be pinched closed later in the life of the well, leading to loss of the connection between the wellbore and the fracture.

While completing wells in the oil-rich Bone Spring sand in the Delaware basin, Devon Energy wanted to optimize flowback operations and mitigate potential fracture connection loss by minimizing the risk of uncontrolled sand flowback and near-wellbore fracture pinchout.

## Integrate well and geomechanics data into advanced poststimulation flowback design

Schlumberger worked with Devon Energy to deploy AvantGuard advanced flowback services to develop a customized predictive flowback strategy based on choke management. Comprehensive well testing data, including high-frequency fluid rates, sand rates, wellhead pressure, and solids and water samples, were gathered and analyzed for two of the operator's wells in the basin.



*The results of Well 1 in the Permian basin in comparison with the modeled SOE indicated that rates were above the level of proppant pack stability.*

## CASE STUDY: AvantGuard flowback services' strategy and monitoring optimize fracture connectivity, Permian basin

The team proposed using the SOE approach to ensure preservation of connectivity between the hydraulic fractures and the wellbore during the lifetime of the well. The analysis revealed the following conclusions for the flowback operations conducted in Well 1:

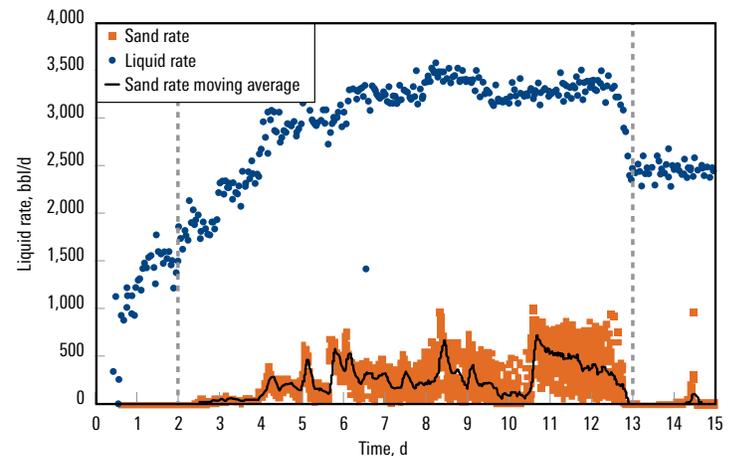
- insufficient effective stress on the proppant was applied at the beginning of the flowback operations
- flow rates exceeded the limit for proppant pack stability at 2,000 bbl/d
- rates were reached beyond the recommended SOE to create unpropped cavities near the wellbore
- expected loss of fracture connectivity at bottomhole pressure less than 3,250 psi was due to closure of unpropped cavities, in turn limiting production performance.

AvantGuard Observe\* flowback transient monitoring and analysis was used for real-time monitoring of flowback operations in Well 1, including the collection of samples of produced solids and liquids. Laboratory analysis identified that the solids returned to surface were proppant, and later samples contained smaller-size particles compared with earlier-acquired samples, indicating a certain degree of proppant crushing. These data were integrated in the design basis to propose a less aggressive flowback strategy that considered formation and fracturing design variables and changes in the proppant type to mitigate crushing potential for the subsequent wells.

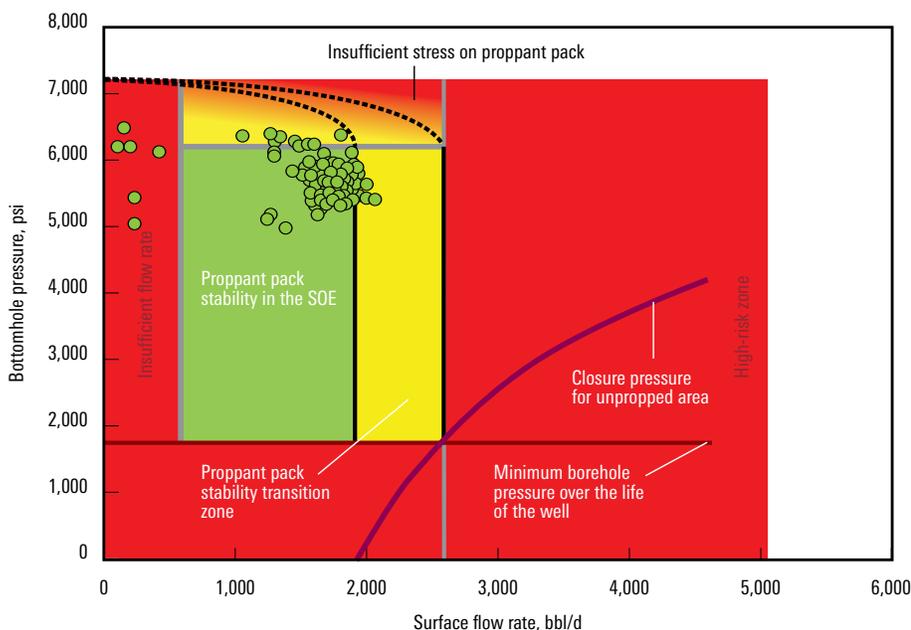
Continuous solids monitoring by AvantGuard Observe monitoring and analysis detected changes in solids production over time. The trend on the solids rate indicated an increase in continuous solids production at flow rates greater than 2,000 bbl/d, correlating with the SOE predictions. Further analysis of the SOE indicated that the maximum production rate of 3,580 bbl/min should result in the creation of unpropped zones, which may cause pinchout later during the lifetime of the well at a bottomhole pressure of 3,250 psi. This conclusion was later confirmed by rate transient analysis after a decrease occurred in the bottomhole pressure below the predicted level.

### Make better-informed decisions on future wells

Based on the results obtained in the monitoring phase, Devon Energy changed the completion design of its subsequent wells to ensure that flowback operations were completed within the SOE outlined with Schlumberger. This considerably reduced the amount of solids produced, with only traces of sand detected at the beginning of flowback in Well 2 and none at the end of the operation, mitigating the risk of proppant conductivity damage and decreasing the risk of near-wellbore fracture closure.



The sand rate measured by using a continuous solids monitoring device (orange) and liquid rate (blue) obtained by AvantGuard Observe monitoring and analysis in Well 1 indicate that the start and stop of transient and continuous sand flow correlates with when the liquid rate was above about 2,000 bbl/d.



By following the customized AvantGuard services' flowback strategy, the flow rates in Well 2 were within the SOE limit recommended for maintaining a long-term connection of the hydraulic fractures to the wellbore.

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