StageFRAC Service Increases Production by 230% in Offshore West Africa Sandstones

Case study: Hydraulic fracturing optimizes production in low-permeability offshore wells

**Challenge**
Stimulate wells in offshore West Africa sandstones to revive low-performance reservoirs and develop previously abandoned low-deliverability reservoirs.

**Solution**
Use StageFRAC\(^*\) multistage fracturing and completion service for accurate fracture placement with only one vessel mobilization and hook-up per rig and minimal time between treatments.

**Results**
Increased stabilized production from recompleted cased hole wells to 1,905 bbl/d from 590 bbl/d. Stabilized production from wells that had been considered uneconomical to 2,000 bbl/d.

**Matrix acidizing offshore**
Eni’s offshore operations near the Congo coast in West Africa consist of aging brownfields with large reserves. These low permeability, consolidated formations were not considered to be economical because using a conventional matrix acidizing stimulation method did not increase production. Matrix acidizing was used in these fields to eliminate completion skin or to reach slightly negative skin, but production levels were low.

To optimize production in three existing cased hole and perforated wells in the Kitina field, Eni chose the StageFRAC service that enables multistage hydraulic fractures in an uncemented wellbore in a single pumping treatment. Hydraulic fracturing, which is used onshore with good results, is not commonly applied offshore.

Depending on the success of the treatment in the Kitina field, Eni would test the StageFRAC technology in a virgin oil reservoir in the adjacent offshore Foukanda field.

*Fold of increase of 3.3 (+ 230%) with no impact on GOR.*

**Graph**
- Flow of oil, bbl/d
- GOR, Sm3/m3
- Water cut, %

Dec-04 Dec-05 Dec-06 Dec-07

Flows of oil, bbl/d

Kitina - Level 3A

Fold of increase of 3.3 (+ 230%) with no impact on GOR.
Case study: Hydraulic fracturing optimizes production in low-permeability offshore wells

Hydraulic fracturing offshore
Using the StageFRAC service, openhole packers are run on conventional casing to segment the reservoir. Ball-activated sleeves are placed between each set of openhole packers. During pumping, balls are dropped from the surface to shift each sliding sleeve open, isolating the previously fractured stages. This mechanical diversion, combined with advanced Schlumberger fracturing fluid systems, allows for precise fluid placement, complete zonal coverage, and more effective fracture conductivity. A large stimulation vessel capable of fracturing six or more zones sequentially using the StageFRAC service can perform an operation in 6 hours that once took 6 weeks. At a rig cost of USD 300,000 per day, the total rig cost would be reduced to USD 75,000 from USD 12.6 million using the StageFRAC service.

Over a 3-month period, eight hydraulic fractures were placed in three recompleted cased hole wells in the Kitina Field, with encouraging stabilized production increases. As a result of the successful treatment in the Kitina field, two subhorizontal openhole wells in the Foukanda field were completed using the StageFRAC service.

Optimal production
Before fracturing, production from the Kitina field wells was approximately 590 bbl/d. Ninety days after treatment, there was an overall steady-state increase in production to 1,950 bbl/d, a fold of increase of 230%. The wells in the Foukanda field delivered an initial production rate of 3,000 bbl/d, which stabilized to 2,000 bbl/d after 90 days.

Eni plans to use the StageFRAC service for future offshore completions to achieve higher levels of production, to cut fracturing completion times from weeks to hours, to cut fracturing costs from millions to thousands of dollars, and to shorten production time to market.

Production Rates Before and After StageFRAC Completions

<table>
<thead>
<tr>
<th>Well name</th>
<th>KTM-W6</th>
<th>KTM-111</th>
<th>KTM-107</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fractures</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Reservoir</td>
<td>Kitina 3A</td>
<td>Kitina 3A</td>
<td>Kitina 3A</td>
</tr>
<tr>
<td>Permeability, mD</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Prefracture oil flow, bbl/d</td>
<td>160</td>
<td>300</td>
<td>130</td>
</tr>
<tr>
<td>Initial postfracture oil flow, bbl/d</td>
<td>2,100 (× 10)</td>
<td>900 (× 3)</td>
<td>1,000 (× 7)</td>
</tr>
<tr>
<td>Steady-state postfracture oil flow, bbl/d</td>
<td>600 (× 3)</td>
<td>650 (× 2)</td>
<td>700 (× 4)</td>
</tr>
<tr>
<td>Delta steady state, bbl/d</td>
<td>+ 440</td>
<td>+ 350</td>
<td>+ 570</td>
</tr>
</tbody>
</table>

"The multistage fracturing technology has opened up possibilities for production optimization and reserves increase, not only in Kitina, but also in many other low permeability reservoirs in Congo previously considered noneconomic. The technology was tested again in a virgin oil reservoir of the nearby offshore field Foukanda with extremely successful results. The multistage hydraulic fracturing technology is now the key for Eni Congo to rejuvenate low-performance reservoirs and to develop previously abandoned low-deliverability reservoirs."

Loris Tealdi
Reservoir manager / Chef du departement gisements
Eni Congo S.A.

www.slb.com/stagefrac