An operator in the Granite Wash play in the Texas Panhandle needed to reduce the effect of offset well interference, which can occur when fractures from a new well cause reservoir communication with a nearby producer well. This interference has grown into a significant issue in infill drilling programs, reducing hydrocarbon recovery, causing downhole pressure variations, and increasing water production.

The plug-and-perforate (PnP) fracturing technique commonly deployed in the Anadarko Basin uses hydraulic pressure to fracture three sets of perforation clusters simultaneously per stage. A common assumption is that fracture areas in the formation around each cluster are uniform. In reality, fractures are more complex and not so predictable. Because the pressure is distributed across multiple clusters, tight formations can reduce fracture lengths in some clusters while weak points in the formation can increase fracture lengths in others. This leads to unpredictable fracture geometries, increasing the likelihood of offset well interference with neighboring wells, leaving reserves untapped.

The Baker Hughes OptiPort™ multistage fracturing system consists of coiled tubing-operated fullbore sleeves designed to allow a nearly unlimited number of single entry fracture stimulations while providing exceptional speed, reliability, and flexibility. A major benefit of the system is that it uses targeted stimulation to complete one controlled fracture at a time, as opposed to fracturing multiple perforation clusters at once. The Baker Hughes team developed a plan alongside the operator to use the OptiPort system in a new infill well to evaluate the effects of this targeted stimulation technique on the interference of a neighboring offset producer well.

The targeted infill well was located just 1,580 ft (481.6 m) from the offset producer well. It was drilled according to plan to 16,060 ft (4895.1 m) measured depth with a 4,191-ft. (1277.4-m) lateral that mirrored the trajectory and depth of the producer well. 36 OptiPort sleeves were run as part of the 5.5-in. casing string to mimic the standard 12-stage PnP design with three clusters per stage.

With the completion string in place, the Baker Hughes team ran the specially designed coiled tubing bottomhole assembly (BHA) to the toe of the well. A typical BHA consists of a mechanical casing collar locator

Results

- Dropped offset well interference effects by 85%
- Optimized fracture treatment control and efficiency
- Dramatically reduced required proppant, fluid, and HHP

Challenges

- Operator needed to increase recovery from assets through infill drilling campaign
- Operator needed to minimize effect of offset well interference on production

Baker Hughes solution

- Deployed 36-stage OptiPort fracturing system to mimic 12-stage PnP operation
- Compared results from PnP and OptiPort treatments to test system value
- Monitored offset producer well during infill well treatment to measure interference
used to position the BHA across each sleeve, and a packer that assists with opening the sleeves and providing isolation from the previously fractured zones. After opening the bottom sleeve using hydraulic pressure, the first frac stage was pumped. The BHA was then moved up to the next OptiPort sleeve, where the packer was set, the sleeve was opened, and the formation fractured. This process was repeated for all remaining sleeves in the lateral.

Step-down tests were performed in multiple stages in the infill well to correlate formation exposure with the producing offset well.

Compared to data collected during PnP treatment of the offset well, the OptiPort system reduced proppant needed per cluster by 42%, fluid per cluster by 79%, hydraulic horsepower (HHP) required by 71%, and fracture half-length by 56%. The end result was a controlled treatment that dramatically reduced the required HHP and equipment.

The original producer well was allowed to flow during infill well stimulation. It recorded an initial slight increase in water production, but gas rates remained unchanged and condensate leveled off at 90% of the original production rate.

The OptiPort multistage fracturing system enabled the operator to accurately control the stimulation treatment in a cost-effective manner and ultimately minimized offset well interference. Both tracer and production data suggest that using the OptiPort system in infill wells in the Granite Wash play can reduce offset well interference by up to 85% compared to historical data from the area. Using this targeted stimulation technique enables additional infill drilling with greatly reduced interference, ultimately allowing operators to maximize drainage from existing acreage by producing more hydrocarbons from infill and existing wells.

Fracturing Method Comparison—Actuals

<table>
<thead>
<tr>
<th></th>
<th>PnP</th>
<th>OptiPort System</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5% acid</td>
<td>1,000 gal / 3785 l</td>
<td>1,000 gal / 3785 l</td>
<td>0%</td>
</tr>
<tr>
<td>Proppant per cluster</td>
<td>98,252 lbm / 44 566 kg</td>
<td>57,200 lbm / 25 945 kg</td>
<td>-42%</td>
</tr>
<tr>
<td>Fluid per cluster</td>
<td>12,000 bbl</td>
<td>2,500 bbl</td>
<td>-79%</td>
</tr>
<tr>
<td>Hydraulic horsepower required</td>
<td>14,900 hhp</td>
<td>4,300 hhp</td>
<td>-71%</td>
</tr>
<tr>
<td>Fracture half-length modeled</td>
<td>2,500 ft / 762 m</td>
<td>1,100 ft / 335 m</td>
<td>-56%</td>
</tr>
</tbody>
</table>

Fracturing method comparison summary

Oil (red) and gas (green) production can fall significantly in an existing well when an infill well is treated (vertical red dotted line)

Offset well production after a nearby in fill well was treated using the OptiPort fracturing system—gas production was not affected and condensates leveled at 90% of the pre-treatment rate

© 2014 Baker Hughes Incorporated. All rights reserved.