SLAP-32

Passive sand control through efficient oriented perforating offshore deep water West Africa

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ABSTRACT:

Drilling for and producing oil and gas from deep-water African reservoirs creates many engineering and technical challenges. The oil and gas reservoir itself can be as much as 10 kilometers below sea-level, under kilometers of water, hard rock, thick salt and tightly-packed sands.

Increasing hydrocarbon production, while maintaining a moderate-to-low associated risk and cost, is a primary challenge for African operators in deep-water operations. The method enabled the operator to eliminate runs to confirm the orientation of the previous oriented systems. The operator has also implemented dynamic underbalance and the critical prejob and post job analysis have shown that the safe surge pressure for these wells have not been compromised as confirmed by the pressure gauges.

Life Cycle Cost

- Life Cycle cost of a Production platform paper
- Developing a formula for determining the cost of a production facility… and it broke it into three areas.

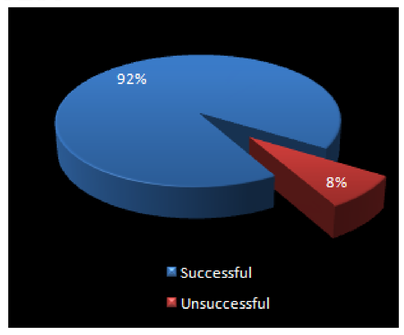
❖ Capital- Talk about costs i.e.- construction, license, permits, commissioning, shipping, cranes, personnel, etc

❖ Operating- Fuel, communications, supply boats, crew boats, helicopter, catering, staff, etc

❖ Deferred production

Orientation Failures- OTC 19130

- Deviations from recommended design
- Challenging well parameters
- Poor operational practices.
- A few cases the causes of poor orientation accuracy remain unresolved.



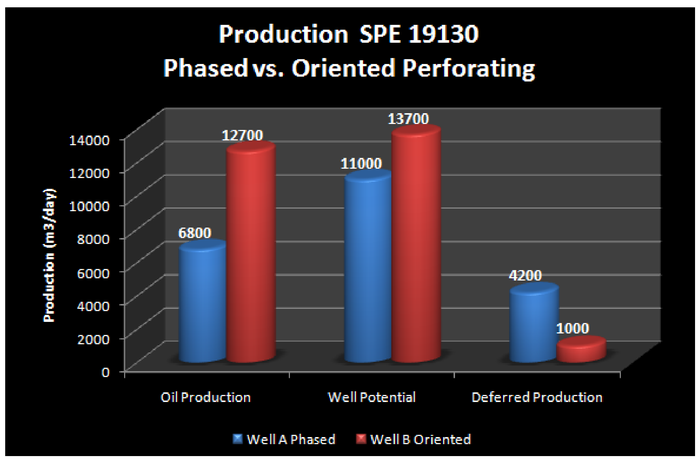
OTC paper identifies in the study that 8 percent of oriented perforating jobs ended in sub optimization which means higher risk of sand production. The majority of these are associated with systems that rely on orientation devices that can be influenced by contact with the casing.

Asset Effects

Sand also has some devastating effects on the asset itself.

- On the simplest end you may have to shut in a well in order to get a Coil unit to clean out sand if possible (subsea)
- Erosion downhole can leave the casing unsupported and there have been cases of collapsed casing.
- If you are trying to use smart well smart well completions, these can be fouled or eroded by the sand.
- And the worst case is if we have something like this, a cut out surface choke, which could threaten the staff and production equipment.

Effects on Production



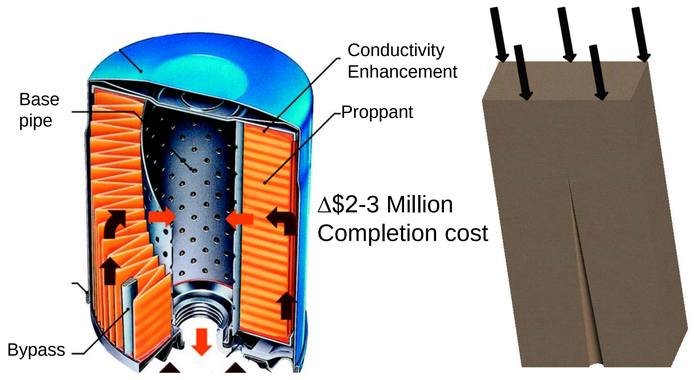
Sand Control - Active vs. Passive

The 0perator in Angola followed two sand control strategies. The primary was active sand control which is similar to building a down hole version of an oil filter.

The other strategy is cased hole Oriented Perforating or CHOP. CHOP completion rely on orientation of the Perforation to be parallel to the Maximum Stress Plane.

If Perpendicular stress will try to collapse tunnel, producing sand, especially with depletion, water on set or high rate gas.

Changing to Oriented the stress has a smaller area to work on and the rock retains its strength longer during depletion.



Δ$2-3 Million Completion cost

Increasing the Reliability

On Deep-water field in particular was trying to use a previous generation of orientation for sand control. These systems and many still used in the industry today allow the casing, friction and well bore debris to interfere with the orientation of the guns. In order to make sure the charges were oriented towards the max stress plan a wireline gyroscope would be run in to verify orientation.

If it was found to be out of orientation, rotation and manipulation of the string were required and the gyro run again. Despite this some of the concerns identified in OTC 19130 found there way into the completion and orientation was not as precise as needed.

Transferrable Solutions

- Guaranteed flow assurance with a rate of 6,000 m^3/day(37,600 BOPD)
- 20 percent increase in Norne Field production

So the technology that had been developed in Norway was an obvious solution.
This technology orienting system was independent of the casing and gave a higher reliability in orientation.
Operators in the North Sea has used this technology to get these type of results.

Adapted to Angola Requirements

- 9 5/8 Casing,
- Permanent Completion
- Gyro Elimination
- Well Integrity
- Dynamic Underbalance
- Operational savings of 50 Hours
- 6 wells on production – no additional sand accumulation
- “We have not seen evidence of continuous sand production on the wells even with 70% water cut.”

But it was not a matter of just shipping the equipment to Angola. The system had to be upsized for 9 5/8 casings. Which also meant that a shot density could be increased to 6 spf. The higher reliability and the elimination of the gyro meant that the operator could use the system in a permanent completion, which meant the well did not have to be subjected to kill pills or fluid loss mechanisms and the well after perforating could go straight onto production.

The system was also tailored to provide a Dynamic Underbalance effect to remove near well bore damage.

Operational on one well the operational savings was over 50 hours.

To date 6 wells have been put on production using the CHOP completion design and there has been no additional sand accumulation in the production of these wells.

Client Value Added

“An Estimated 36 hours of rig time has been eliminated, since it is no longer necessary to have the orientation of the guns verified by a Gyro, and the overall perforating interval can be increased to enable one run in the hole…. cost savings of *$1,462,500* USD .”

- North Sea Operator Primary completion in 7” casing
- Shallow Gas Zone in 9 5/8 Discovered
- Used 7” Internally oriented system to capture additional production

And in a small twist of fate, in 2012 a North Sea operator was planning a new drill with a 7” casing string. After setting the 9 5/8 intermediate casing they determined there was a shallow gas zone that could be comingled with the primary target. Both the 7” and the 9 5/8 were completed with the shallow zone using the system that had been developed for Angola to capture the additional production with the same reliability of oriented perforating.

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What questions does oriented perforating need to answer for you?