

Multi-Well Acid Stimulation

Multi-well campaign - Ghana, West Africa

Project Overview

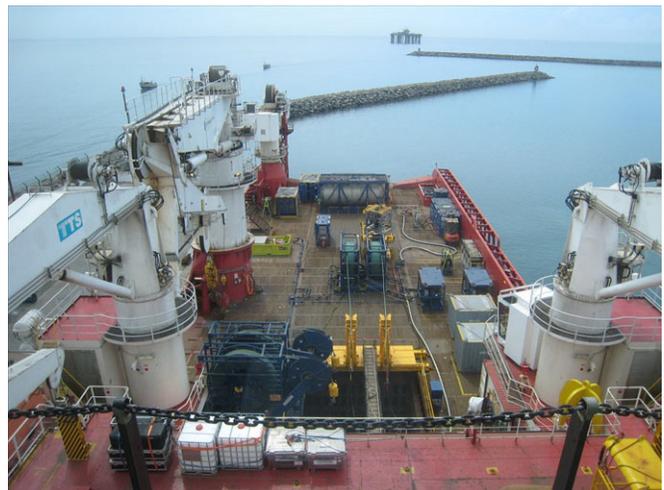
Stimulate five wells located 60 miles offshore in Ghana, in order to increase production with limited capital investment.

Issue

Production of the client's wells had decreased significantly due to a combination of fines mobilization, calcium carbonate, and scale accumulation.

The Oceanengineering Plan

To provide the most economical solution, Oceanengineering proposed a dual-vessel stimulation plan. The Multi-Purpose Service Vessel (MPSV) deployed the coiled tubing, crane operations, dual Millennium® work class ROVs, and well stimulation tool, while the well stimulation vessel provided the fluids and pumping for the stimulation. Four Oceanengineering innovative Open-Water Coiled Tubing units were mobilized on the MPSV, in order to provide up to 16 bpm (barrel per minute) flow rate to the well stimulation tool.



Four coiled tubing reel layout on the MPSV



MPSV and stimulation vessel during Ghana well stimulation

Multi-Vessel Acid Stimulation

To supply the necessary volume of stimulation fluid during operations, the stimulation vessel pumped chemicals through a high-pressure hose to the construction vessel. Using a two-vessel solution enabled the campaign to save time by equipping the stimulation vessel with all chemicals needed for the entire campaign at once. If a single vessel solution was selected, this would have required a trip back to the shore base to refill tanks after each well.

The downside to a multi-vessel solution is increased project risk due to simultaneous operations and the need for greater communication. In order to mitigate this risk, transponder frequencies for the entire field were managed by one individual, the Field Mooring Master. This ensured constant and reliable positioning information for all DP rigs and vessels in the proximity of the operation.

As the vessels were required to remain in close proximity to each other for extended periods of time, both vessels operated in dynamic positioning mode during pumping operations.

The MPSV used a long base line (LBL) acoustic array for maintaining positioning relative to the subsea assets. Meanwhile, the stimulation vessel used a fan beam configuration to maintain an offset of roughly 100' from the MPSV.



Well Stimulation Tool (Enabled for four Coiled Tubing Risers)

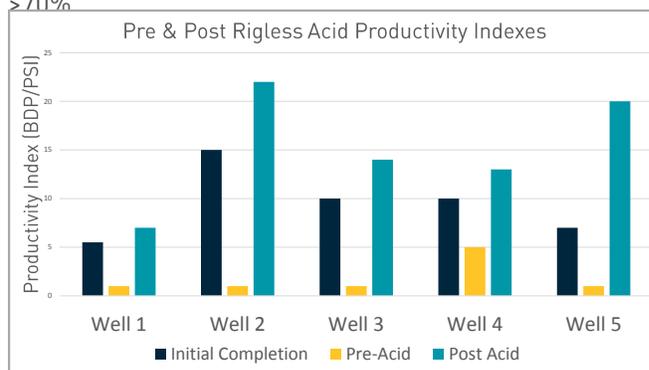
Upgrading the Well Stimulation Tool

In order to satisfy the required stimulation flow rate, Oceaneering modified its original well stimulation tool to accommodate four open water coiled tubing risers. This effectively doubled the achievable flow rates, allowing the operator the ability to pump the optimal flow rate based on each well's unique characteristics.

A major concern for all jobs requiring hazardous chemicals is the prevention of any leaks, thus protecting personnel and the environment. Therefore, the connections from the coiled tubing to the well stimulation tool were made via Oceaneering no-leak hot stabs. By employing the use of no-leak hot stabs, the tooling cost was reduced, and ROV operations were simplified.

Result

For the five well campaign, the average well experienced a 350% increase in Productivity Index (BPD/PSI) and a production rate (BOE/day) increase of >70%.



Job Statistics

Tree Type	5-1/8 in FMC Enhanced Horizontal Tree
Tree Interface	18-3/4 in 15K Torus IV Connector (FMC)
Water Depth	4,420 FSW
Avg. Pump Rate	~11 bbl/min
Avg. Fluid Injected	1,370 bbl/well
Reservoir Depth	12,000 ft TVD
Injection Pressure	5,000 psi