MATURE FIELDS

CASE STUDY

Drilling Optimization in Karim Small Field Saves Drilling Time and Eliminates Wellbore Instability

IMPROVED OPERATIONAL PERFORMANCE RESULTS IN DRILLING WELL 16 PERCENT FASTER THAN PLANNED

OMAN

CHALLENGES

- Design a creative and optimized solution in Oman's KSF region to reduce the drilling time and overall well cost
- Determine the root cause of tight-hole and stuck-pipe events
- Minimize NPT
- Optimize the drilling performance

SOLUTIONS

- Develop optimized drilling procedures based on detailed offset well data analysis
- Use Landmark drilling engineering software to calculate optimum drilling and tripping parameters
- Utilize sized BARACARB® bridging agents from Baroid to enhance wellbore stability
- Employ PWD tool from Sperry Drilling for hole cleaning and wellbore stability monitoring
- Coordinate and analyze implementation of drilling optimization strategy with all Halliburton PSLs in order to deliver ultimate drilling performance

RESULTS

- Eliminated the induced wellbore instability problems
- Drilled the well 16 percent faster than planned
- Saved 8.2 percent of the total planned well cost
- Completed entire operation with no NPT related to wellbore stability issues

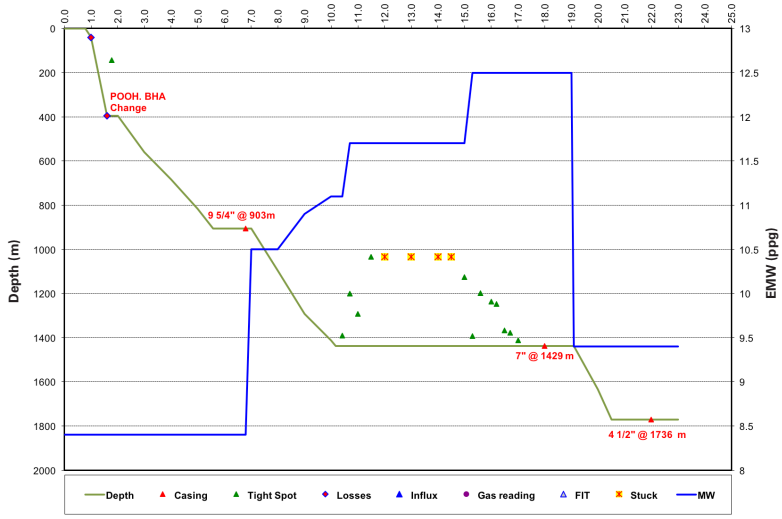
OVERVIEW

Halliburton Project Management (HPM) was tasked with optimizing the drilling performance of Medco Arabia Ltd. in its development drilling campaign in the Karim Small Fields (KSF) region of southern Oman. This project included providing engineering and operational support. A creative and optimized solution was needed to reduce the drilling time and overall well cost. Considerable collaboration with the customer and detailed offset well data analysis would be needed to determine the appropriate solution to meet project requirements at the lowest cost possible.

CHALLENGES

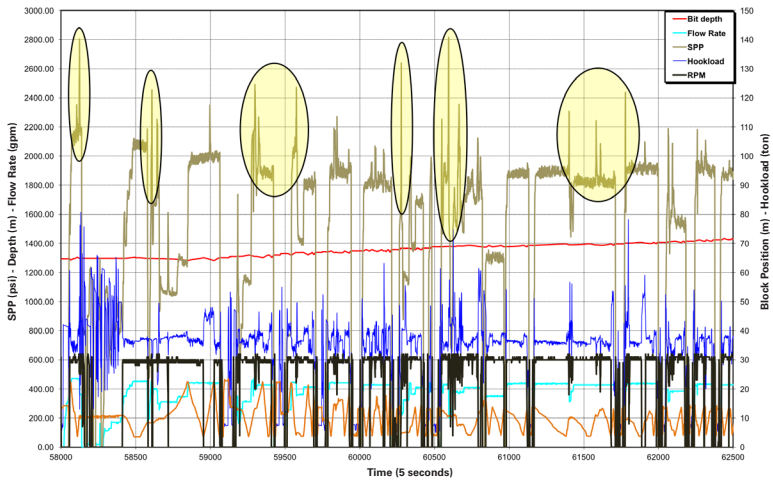
The operational performance of previously drilled wells in the KSF region was affected by a high record of non-productive time (NPT). The majority of this NPT (66.1 percent) was attributed to wellbore instability problems such as tight-hole and stuck-pipe events experienced in an 8½-inch hole section. NPT of 143 hours was recorded while tripping out with an 8½-inch bottomhole assembly (BHA) in Well "A." The HPM team would need to analyze data, coordinate with Halliburton product service lines (PSLs), and implement a solution at the lowest cost possible.

Well "A" – Drilling Events



Tight-hole and stuck-pipe incidents were recorded in the 8½-inch hole during tripping in/out for Well "A."

8½-inch hole tripping from 1293 meters to 1438 meters (4,242 feet to 4,718 feet)



Time-based tripping parameters for Well "A." Excessive reaming actions were applied while tripping in the 8½-inch hole section (with standpipe pressure spiking up to 1,000 psi, resulting in formation destabilization).

SOLUTIONS

To optimize drilling performance and reduce overall well costs, the HPM team first performed a detailed offset data analysis. In addition, other Halliburton PSL teams were brought in to analyze the data and offer solutions. An overall collaborative solution was then created.

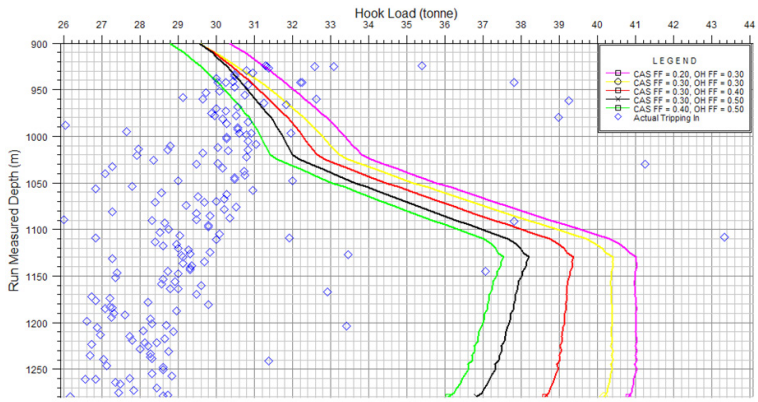
Drilling engineering software from Halliburton Landmark was utilized to understand the drilling geomechanical events and to calculate the optimum drilling and tripping parameters. The Sperry Drilling Pressure-While-Drilling™ (PWD) tool was used to confirm the hydraulic models and to measure the amount of surge and swab pressure exerted over the formation due to excessive reaming actions. Baroid sized BARACARB® bridging agents were implemented in the drilling fluid system to enhance wellbore stability.

A detailed report was presented to Medco Arabia Ltd., with the following recommendations:

- Changing flow rate and/or pump pressure rapidly could have a bad effect on wellbore stability.
- Considering the colloidal materials (the sized BARACARB bridging agents) in the drilling fluids would help stabilize the wellbore by building the filter cake and filling the induced fracture with the solids to bridge off any fractures.
- Excessive change in pump pressure could have a detrimental effect on the stress and strain of the wellbore, possibly resulting in sloughing. Change in the circulation rate or excessive reaming actions would remove the colloidal materials and increase the sloughing volume.
- Landmark engineering software should be used to establish a torque and drag model prior to any BHA run (especially for highly deviated and horizontal wells). The results should be discussed with the drilling supervisor. The operator should also ensure that the pickup weight, slack-off weight, and rotating off-bottom weight are recorded with every stand, and are used in the model to evaluate the actual hole conditions.

The operator was able to run the 7-inch and 4½-inch production casing without any downhole problems.

Well "A" – Friction Factor Estimate



Friction factor estimate for Well "A," using measured hookload readings, indicated that the 8½-inch BHA was dragging cutting during tripping in operation.

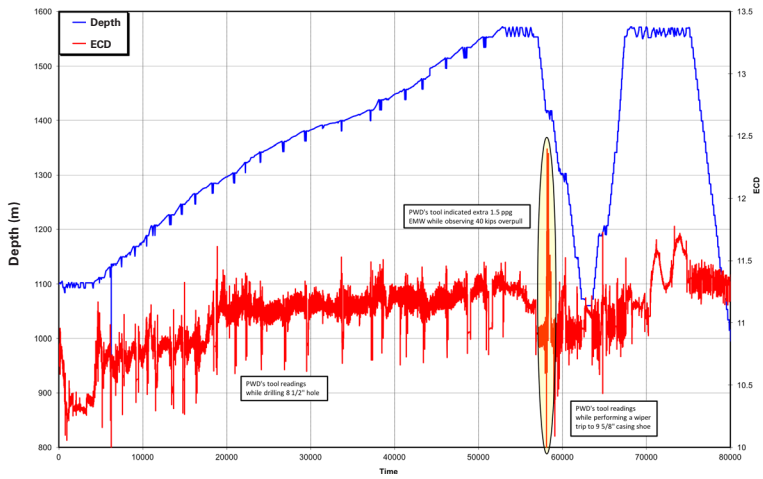
- Reaming down should ensure a cleaner hole, but could also cause unnecessary surges below any packoff or partially packed-off zone. As the hole began to break down in Well "A", the trip from the bottom of the hole needed to be pumped out slowly without rotation to avoid swabbing and causing further damage to the formations.
- Avoid the whiplash effect as indicated from the time-based drilling parameters.

RESULTS

Through close collaboration with the customer, Halliburton was able to engineer a solution for ultimate drilling performance optimization.

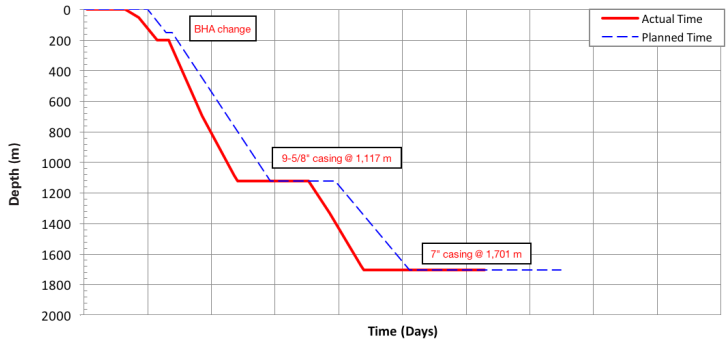
- Various engineering simulations allowed the customer to drill the well 16 percent faster than planned and to successfully overcome the induced wellbore instability problems.
- Landmark drilling software allowed the operator to improve the drilling efficiency and decision making in the KSF region, thus reducing NPT. The average recorded NPT in the KSF region was reduced by 15.2 hours/month (mainly related to logistics) and to zero hours/month (related to wellbore stability).
- The operator saved 8.2 percent of the total well cost after implementing the HPM team's recommendations.
- No stuck-pipe events were encountered after implementing the HPM team's drilling and tripping procedures.
- The signs of packoff events measured by the PWD tool allowed the engineering team to calculate and optimize the drilling and tripping procedures.
- The operator was able to run the 7-inch and 4½-inch production casing without any downhole problems.

Well "B" – PWD Tool Data – Drilling/Tripping 8½-Inch Hole



This graph shows the PWD tool reading while drilling and tripping with the 8½-inch BHA in Well "B."

Well "C" – Time/Depth Graph



The operator saved 2.4 days against the planned time for Well "C" after implementing the HPM team's recommended drilling and tripping procedures.

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