MATURE FIELDS

CASE STUDY

Successful Drilling of an Exploratory Well 30 Days Ahead of Schedule

DRILLED THE DEEPEST EXPLORATORY WELL IN THE BASIN

VERACRUZ, MEXICO

CHALLENGE

Drill a deep (25,262 ft / 7700 m) exploration well

- High geologic complexity and uncertainty
- Known low pressure zone with historically high fluid loss volume while drilling nearby wells
- No information to predict the mud window in the deeper sections
- HP/HT environment probable in the target zone

SOLUTION

Re-engineering of the well design and use of available technology

- MPD, Geopilot G, MLPWD solar tools
- Real time operations monitoring
- Real time monitoring of structural geological events and continuous calibration of the mud window
- Use of integrate mud and log tools for hostile environments
- High technology rig provided

RESULT

The drilling of the deepest well in the basin with fewer hole sections than initially designed

- No fluid lost to formation in the depressurized Tertiary production zone
- Successful use of Integrate fluid in the HT/HP Middle Cretaceous section with no fluid lost to formation
- Successful use of specialized drill bits and BHA components
  The well was completed 7 days under the client's schedule

OVERVIEW

SAVED 720 HOURS OF RIG COST

Our client's exploration portfolio included drilling an exploratory well to test a deeper (Mesozoic) structure in the Veracruz Basin. Current production is from the clastic Tertiary section, but the seismic information available showed a deep structure with high potential. This well is located in a structurally complex zone, known to have low pressure gradients, high fluid losses in the producing formations, and the presence of low-angle reverse faults and thrust sheets in the Paleogene and Mesozoic sections.

Halliburton Project Management in Mexico received the information from eight correlation wells within an approximate 30 mi radius (50 Km) and analyzed it in detail, resulting in the re-engineering of the well design. The use of MPD, geo-steering, and MLPWD technology was proposed and accepted, and drilling began.

Real time operations, structural-geological and geomechanical monitoring of drilling events, along with close interaction with all PSLs involved allowed PM Mexico to successfully drill the well to a target depth of 25,262 feet (7700 meters) with minimized fluid loss and 30 days under planned schedule.

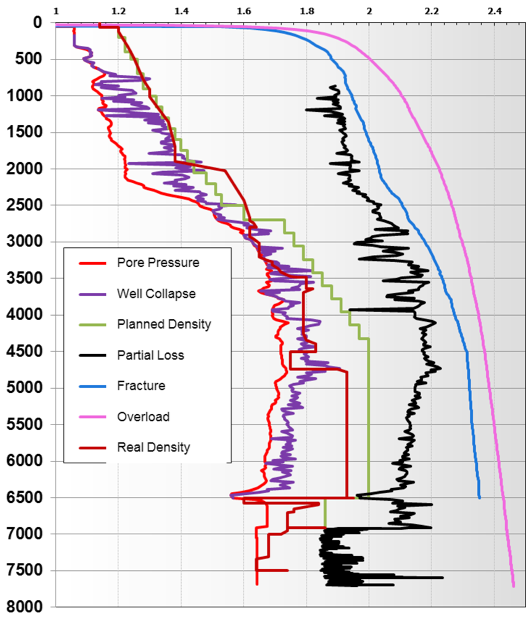
Production tests are now underway and with the well flowing super light oil, new areas of opportunity have emerged for Mesozoic structures in this basin.

Assess	Select	Define	Execute	Evaluate
» Correlation Wells » Geological Events » Formation Integrity » Lessons Learned Application	» Drill Bits & Directional Driling Equipment » Drilling Fluids » Control Methods for Closed Ooperative Windows » Casing Running and Cementing Technologies » Perforation Equipment	» Well Schematic » Operative Window » Drilling Time Reduction » Flat Time Reduction » Logistics	» Collaborative Planning » Engineering & Operations Supervision » Design Adjustments in Real Time (Geology, Geo-Mechanics & Perforation) » Real Time Monitoring » Process Application	» Lessons Learned » Technical and Economic Evaluation

CHALLENGE

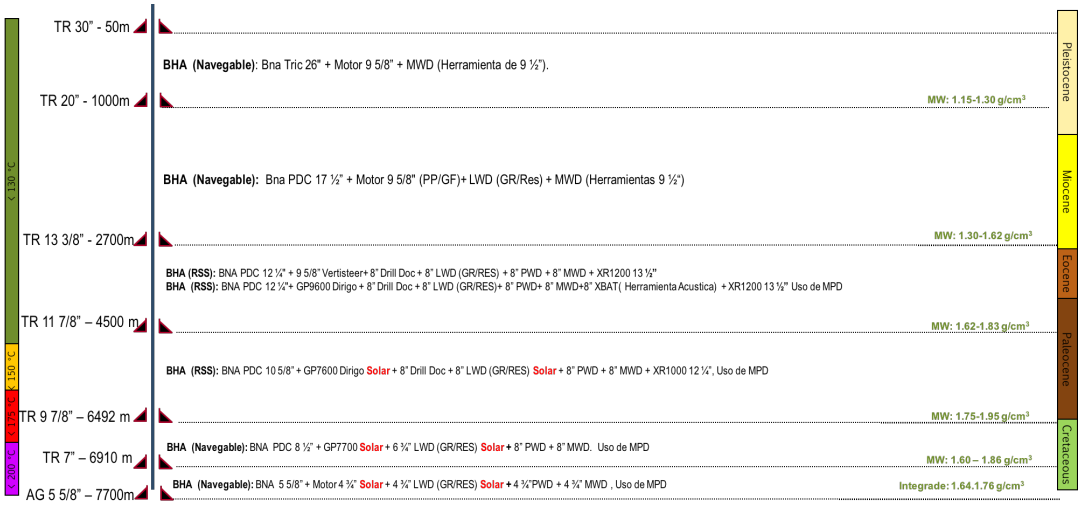
This was the first well to be drilled in the basin with a Middle Cretaceous target at 15,000 feet (4,572 meters). The well needed to pass a depleted, depressurized section that belongs to a producing field with a high historical volume of fluid loss to formation while drilling, in addition, there was no information on how the formations would behave below the Upper Paleocene, as none of the correlation wells had drilled below that level. Seismic information showed a structurally complex area, passing from an extensional regime in the Neogene to

a compressional regime with various low-angle reverse faults and possibly over-thrust sections in the Paleogene and Mesozoic.



SOLUTION

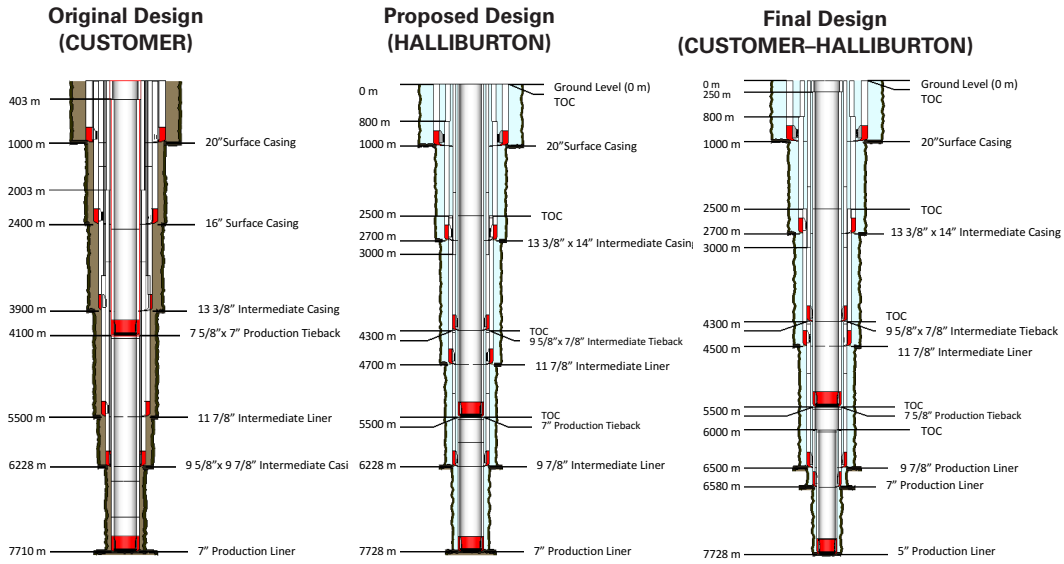
A detailed revision and analysis of the offset well information hand-in-hand with a revision of the well design and engineering data allowed Project Management in Mexico to propose an optimized well construction design that was accepted by the client. Such design proposed the used of MPD, Geopilot and MLPWD equipment and tools that would help fight the geologic uncertainty regarding structural complexity and desirable mud window. Furthermore, real time monitoring of drilling operations, geological/ structural seismic/geomechanical monitoring of LWD logs, and near-real time updates of the probable mud weight for each section helped solve the geological concerns.



RESULT

The new design, which suggested the elimination of two sections (from eight to six) and the use of reamers in only two sections instead of three, allowed the client to optimize drilling times and resources. In spite of the high geological uncertainty this well faced, the team was able to drill the well to target while guaranteeing full well-borehole integrity.

This well is now the deepest well in the Veracruz basin, and is currently undergoing production tests with preliminary results of super light crude from the deep carbonate rocks of the Middle Cretaceous. This has opened the possibility of further prospects at this level as there are other similar structures in the basin.

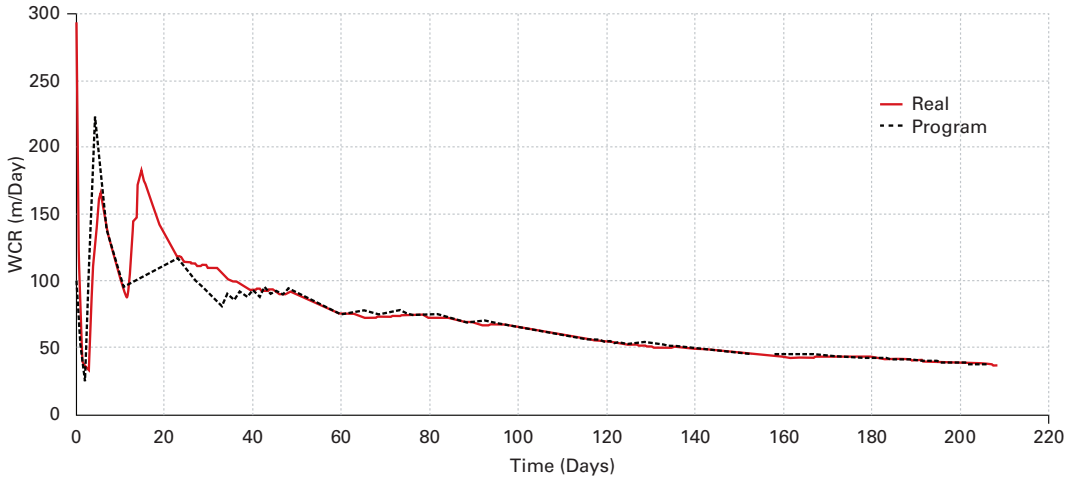


This is the longest and deepest core recovered by Halliburton in Mexico

A special mention must be made of the recovery of 59 feet (18 meter) of core that was 100 percent recovered from 21,561–21,620 feet in the middle Cretaceous. This is the longest and deepest core recovered by Halliburton in Mexico.

Use of MPD equipment, Geopilot GT, MLPWD solar tools and Integrate fluid in the HP/HT section at the end of the well, plus integration of the information in order to monitor and update the mud window in near real time contributed to the proper calibration of the hydrostatic column used during drilling. This in turn minimized fluid loss to the formation, avoiding formation damage and operational risks.

WCR Trend



Successful drilling 30 days ahead of schedule

Well KPIs

Casing (in)	Depth (unit)	Well Plan					Depth	Well Real							
		Drilling Time (Days)	Flat Time (Days)	Total Time (Days)	WCR (m/day)	ROP (m/hr)		Drilling Time (Days)	Flat Time (Days)	Total Time (Days)	WCR (m/day)	ROP (m/hr)	NPT (Days)	Difference (Days)	Ef. (%)
MOB	0		22.00	22.00	0.00	0.00	0		20.46	20.46			0.00	1.54	100
28	50	0.50	1.50	2.00	25.00	0.00	61	0.21	2.04	2.25	27.11	13.15	0.31	-0.25	86.1
20	1000	2.50	6.00	8.50	111.76	20.00	1005	3.79	5.35	9.15	103.22	21.14	1.33	-0.65	85
13-3/8–14	2700	12.50	10.00	22.50	75.56	22.00	2700	3.42	7.85	11.27	105.39	31.47	0.67	11.23	94
11-7/8	4500	15.00	12.00	27.00	66.67	9.30	4500	26.29	9.19	35.48	50.73	6.28	1.42	-8.48	96
9-5/8–9-7/8	6500	32.50	23.50	56.00	35.71	14.00	6494	38.58	24.98	63.56	31.37	4.00	4.19	-7.56	93
7	6580	12.75	24.58	37.33	2.14	2.80	6910	14.15	22.19	36.33	11.45	1.23	5.33	1.00	85
5	7728	28.42	24.13	52.54	21.85	3.80	7700	19.60	30.44	50.04	15.79	4.51	10.10	2.50	80
Total				**205.88**	**37.54**		**7700**			**208.08**	**37.00**		**23.35**		**88.8**

The integration of various disciplines and close teamwork on the project were the keys to successful execution of this well, finishing 30 days under the client's schedule, safely, efficiently and saving 720 hours of rig cost.

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