

“This well could not have been drilled without oil-base WARP technology.”*

Operator Drilling Superintendent

Well Information

Location U.K. North Sea
Spud May 2006
Well type..... Development
Hole Angle Range 78-45°
BHST 244°F (118°C)
Well Depth 7625 m (25,016 ft)
Section Drilled 1885 m (6184 ft)

The Situation

An extended-reach well with a low fracture gradient and a potential for barite sag was required to verify a seismically defined extension. It was anticipated that the well could be completed as a producer, thereby extending the productive limits of the field. The ability to circulate at a rate sufficient to clean the hole and remain inside the ECD window would prove critical to success.

The Solution

A VERSACLEAN* fluid with oil-base WARP technology was selected to provide optimum ECD management and the least potential for sag. An 8.5-in. section was drilled successfully using oil-base WARP technology to keep the ECD well within the fracture gradient and achieve a rapid and efficient increase in drilling weight. WARP technology introduced the added benefit of torque reduction. Because 400-mesh screens were used near TD for fluid cleaning, SAFE-CARB* additive was applied as a bridging package.

The Results

- Measured ECD was well within the fracture gradient and correlated well with predicted values calculated using the VIRTUAL HYDRAULICS* software.
- The maximum measured ECD whilst drilling with WARP was 1.84 SG (15.36 lb/gal). At that same stage, with a conventional VERSACLEAN system, VIRTUAL HYDRAULICS software estimated the ECD would have been 2.01 SG (16.77 lb/gal).
- No barite sag was observed even after 7 days static in the hole.
- Higher flow rates than previously thought possible were achieved.
- No indications of hole cleaning problems were witnessed, even at lower flow rates of 350 gal/min, and the hole was reported in excellent condition after the upper section had remained open for 10 weeks.
- A 25% reduction in rotary torque was achieved as a result of the WARP fluid displacement.
- No logistical problems were encountered with the 1.53- (12.77-lb/gal) and 1.60-SG (13.35-lb/gal) mud or with the 1.9-SG (15.86-lb/gal) “spike” fluid.



The Details

TABLE 1: WARP - VERSACLEAN LTOBM 8.5-in. section

Mud Properties	Program	Minimum	Maximum	Typical
Density, SG	1.50	1.53	1.61	1.53/1.6
Plastic Viscosity, cP	<30	15	25	20
Yield Point, lb/100 ft ²	5 – 10*	5	7	5.7
Gel Strengths, lb/100 ft ²	3-8/6-15	1/3	4/8	3/6
Fann 6 rpm, dial reading	2-6*	2	4	3
HTHP Filtrate @275°F, cc/30min	<3*	0.3	2	1.2
OWR	75/25-85/15	78/22	81/19	80/20
LGS, % v/v	<6.0**	2.2	8.5	5.8

*Critical Property **Excluding SAFE-CARB additive

Table 2: Predicted versus actual hydraulic measurements

	Operator Model	M-I SWACO Model	Actual
Flow Rate, gal/min	475	500	505
ECD, SG	1.78	1.75	1.76
Pump Pressure, psi	4500	4500	4500 (max possible)
Torque		-	20% measured reduction
Friction Factor	0.21	-	0.17

Owing to the use of the oil-base WARP drilling fluid, the overall 8.5-in. section was drilled successfully on this well despite operational challenges that included a twist-off resulting in stuck pipe, drilling of a sidetrack, and a well-control incident. Some mud weight variations were recorded while drilling the section; it was determined that this was due to settling of the calcium carbonate and graphite bridging material and drill solids as opposed to barite sag. Both 325- and 400-mesh shaker screens were used for most of the section drilling; however, it is recommended that they be used earlier to minimize solids build-up. There were some signs of sludge coming over the shakers as a result of regrinding bridging solids and drill cuttings; this is only to be expected in a well where cuttings must travel through a 5-km (16,404 ft), 78° section. The use of fine mesh screens meant that some of the bridging material was removed; therefore the protocol was to add the carbonates just prior to reaching reservoir and the coarser fraction of SAFE-CARB additive was replenished. Pit capacity on the rig was limited to 1.9 SG (15.86 lb/gal). Consequently, the typical 2.2-2.3-SG (18.36-19.19-lb/gal) oil-base WARP concentrate was not used as the spike fluid; rather a 1.9-SG (15.86 lb/gal) WARP fluid.

Questions? We'll be glad to answer them.

If you'd like to know more about the WARP Advanced Fluids Technology product and how it's performing for our other customers, please call the M-I SWACO office nearest you.



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