

*“Oil-base WARP\* Technology helped a client perform a critical liner cement job and achieve zonal isolation in an extended reach well.”*

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**Well Information**

Location .....	UK North Sea
Well type.....	Development
Date .....	May 2007
Hole size .....	8.5 in. (215.9 mm)
Angle at total depth (TD) .....	89°
Borehole temperature .....	275°F (135°C)
Measured depth.....	21,202 ft (6462 m)
Total vertical depth .....	10,769 ft (3282 m)
Section drilled .....	9689 ft (2953 m)

**The Situation**

This extended-reach development well was drilled into a faulted, depleted reservoir with a narrow drilling window (equivalent circulating density [ECD] limit 2.0 lb/gal greater than surface density). The well was successfully drilled to TD using the M-I SWACO\* VERSACLEAN\* oil-base mud weighted to 12.8 lb/gal with M-I BAR\* ULTRA FINE product. A 5½-in. liner was run, but it was calculated that ECD during the cementing operation would exceed formation strength, leading to total losses. Reducing the displacement rate for pumping the cement was not an option as this might result in the predicted cement setting time being exceeded during placement. Thus ECD had to be reduced by alternative means.

**The Solution**

A 12.8-lb/gal VERSACLEAN fluid with oil-base WARP Technology was selected to reduce ECD during this critical phase in the well program. The reduction in ECD provided by the WARP technology allowed the cement displacement to proceed at 5 bbl/min rather than the maximum of 3 bbl/min calculated using a conventional oil-base fluid.

**The Results**

The cement was pumped, and the plug was bumped within 2 strokes of anticipated volumes. The cement was displaced at 5 bbl/min, and the company man on the rig stated later that the cement operation had been a textbook example of excellent performance and teamwork between service companies and the client. No mud losses to the formation occurred.



**The Details**

After running the M-I SWACO VIRTUAL HYDRAULICS\* software, it became apparent that the VERSACLEAN oil-base mud gave an ECD through the liner hanger of 14.78 lb/gal at only 160 gal/min (3.8 bbl/min). This came close to the 14.8-lb/gal ECD ceiling, but was slow enough to mean that the cement would be thickening up before the displacement was complete.

A recalculation using an oil-base WARP fluid (see Figure 1) quickly showed that the ECD would be reduced to 14.10 lb/gal at 160 gal/min. The client used this additional window to increase the displacement rate of the cement to 250 gal/min, giving an ECD of 14.65 lb/gal.

Table 1–Actual properties of mud used in operation.

	<b>OBM weighted with ultra fine barite</b>	<b>WARP Fluid</b>
Density, lb/gal	12.85	12.9
PV/YP	46/21	27/2
6 rpm	11	1
Gels	13/21	2/4
Oil/Water Ratio	76/24	75/25

*All rheological properties measured at 120°F*

After running the liner, the hanger was set and 1000 bbl of WARP fluid were displaced into the well. Although the liner could not be rotated within the torque limits, the client did not expect this to be possible anyway. The cement spacer and cement were pumped, and displaced with VERSACLEAN oil-base mud, weighted with ultra fine barite. The volume of the spacer had been selected to ensure that no WARP fluid was left behind the liner.

The cement was displaced into the well and the plugs bumped to schedule. There were no losses to the formation, even though they would have been anticipated if the ECD was higher than calculated. The liner landing string was unlatched and the well circulated clean with all the WARP fluid displaced out of the well for return to M-I SWACO.

Altogether, the rig reported that 164 bbl of WARP fluid were lost in interfaces with the regular oil-base mud.

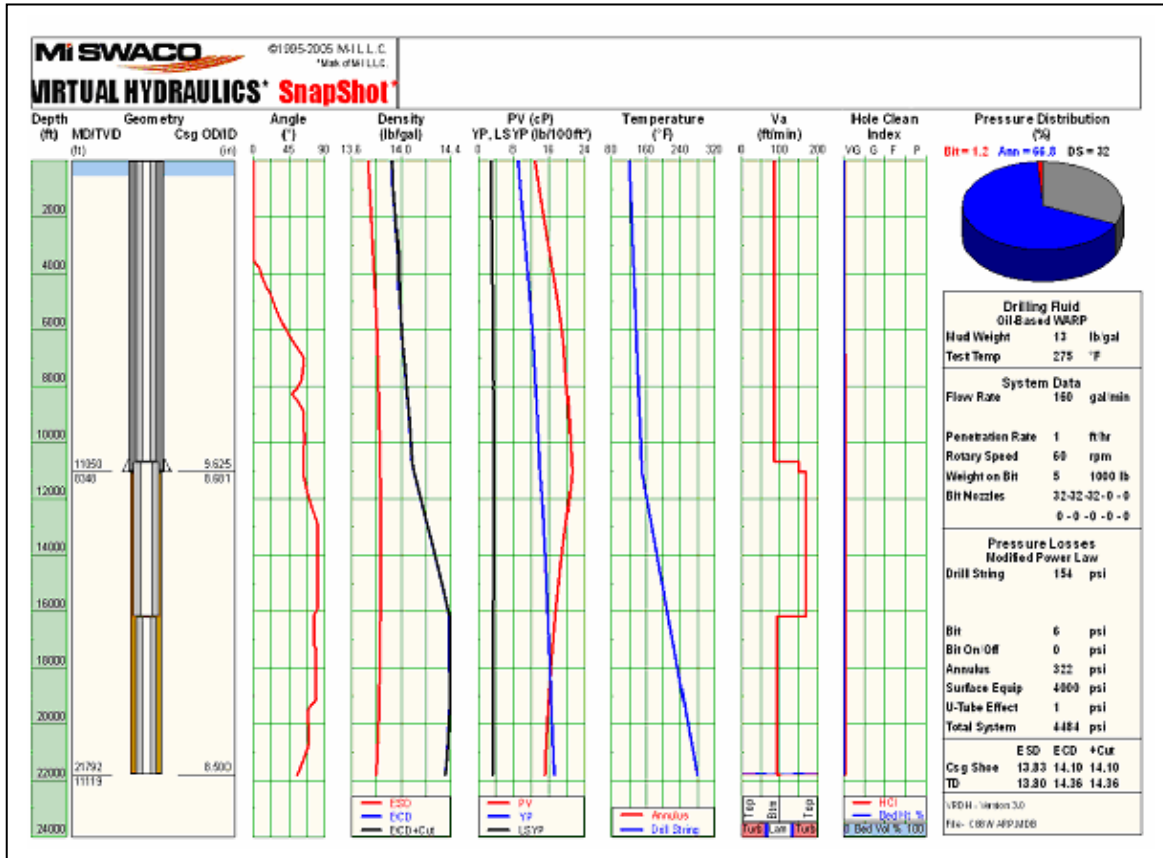


Figure 1. – VIRTUAL HYDRAULICS analysis

*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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