Case Study

MPD Utilized to Complete Drilling Operation with Severe Fluid Losses

ALPINE ENERGY SERVICES

Challenge

- An operator conventionally drilling in the Ferrier area of Alberta encountered lost circulation to the Upper Mannville & Falher coals.
- A 1240 kg/m^3 density fluid had been used to prevent gas influx; this caused severe fluid losses when pumping.
- Four cement plugs were spotted to seal the lost circulation zone. These were unsuccessful.

Solution

- AES equipment and personnel were mobilized to location.
- AES technical specialists reviewed prior drilling data. They determined losses occurred when ECD exceeded 1410 kg/m^3 EMW. Density required to control gas was 1240 kg/m^3.
- It was calculated that mud density could be reduced to 1040 kg/m^3, using surface applied back pressure to increase EMW to 1240 kg/m^3 or higher, if needed.

Results

- The operator was able to drill to TD, run casing, and perform cement job without further losses to formation.
- Pore Pressure and Fracture Pressure were accurately identified and a drilling window of 170 kg/m^3 EMW (4300 kPa) established.
- Performed a Managed Pressure Cement job without any losses or other deficiencies.

Well design and background information

The operator was drilling a horizontal well into the Wilrich formation at a TVD of 2540 m. The well design was a 'modified mono-bore' with 177.8 mm intermediate casing set at 1735 m in the Lea Park formation and drilling 159 mm hole to TD at 5970 m. This wellbore design required drilling through the Mannville coals, which are prone to fluid losses and instability. Mannville group and shallower forma-tions may contain gas at higher-than-normal gradients.

In this case, the oil-based drilling fluid density had been increased to 1240 kg/m^3 to address background gas. When pumping at drilling rates, the ECD increased to 1410+ kg/m^3 EMW and severe drilling fluid losses were encountered in the Upper Mannville/Falher. Four cement plugs were placed in an attempt to heal the losses at various depths to 2647 m (Total downhole losses were estimated at 177 m^3). From intermediate casing to 2647 m losses were at a rate of 21.8 m3/100 m.

MPD Mobilized & Well Drilled to Total Depth

MPD equipment and personnel were mobilized to location after a fourth unsuccessful cement plug. During installation of the MPD system, the oil-based mud system density was decreased to 1040 kg/m^3.

Drilling proceeded with 1.05 m^3/min pump rate and applying 500 – 800 kPa back pressure, adjusting based upon background gas. While making connections, 2000-3000 kPa was applied to control bottoms up gas. Final Pore Pressure was determined at 1170 kg/m^3 EMW and losses were observed when ECD exceeded 1340 kg/m^3 near the end of the lateral section. This was the 'drilling window' used for final calculations.

Drilling fluid losses from implementing MPD to TD decreased to 2.2 m^3/100 m. Minimal losses were reported down hole, with most of the fluid lost to cuttings.

MPD Techniques Used at TD

At TD, swab modeling indicated a 5000 – 4500 kPa would be held to the heel at 2208 m. At this point, the well was displaced to a 1270 kg/m^3 trip fluid following the ECD-M displacement procedure.

When running liner, a design was implemented to displace light 1040 kg/m^3 fluid to heel leaving 1260 kg/m^3 fluid above.

Final cementing used Managed Pressure to successfully lower fluid density and prevent losses. MPD was the key to successful completion.

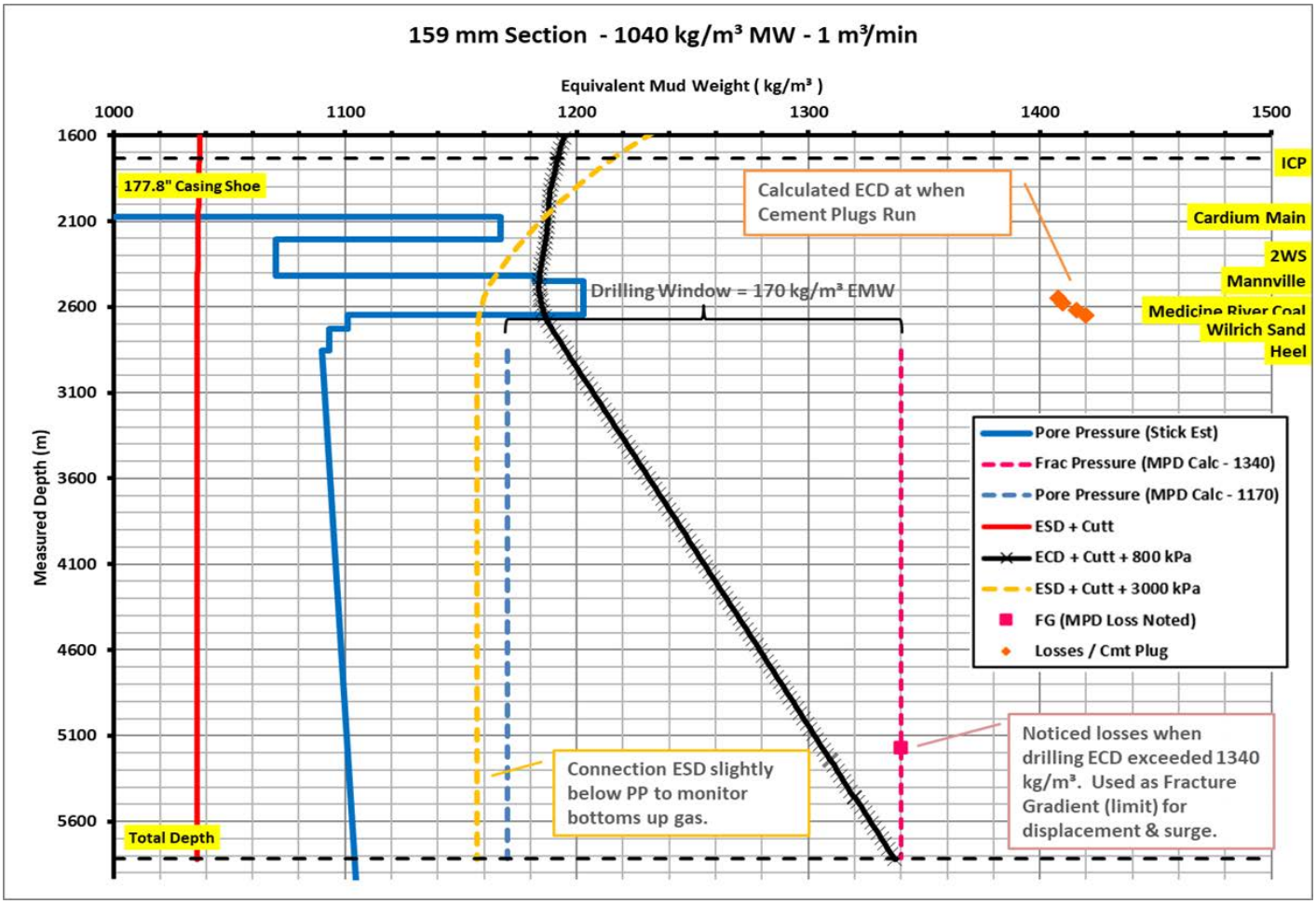

Figure 1: TD well conditions with MPD

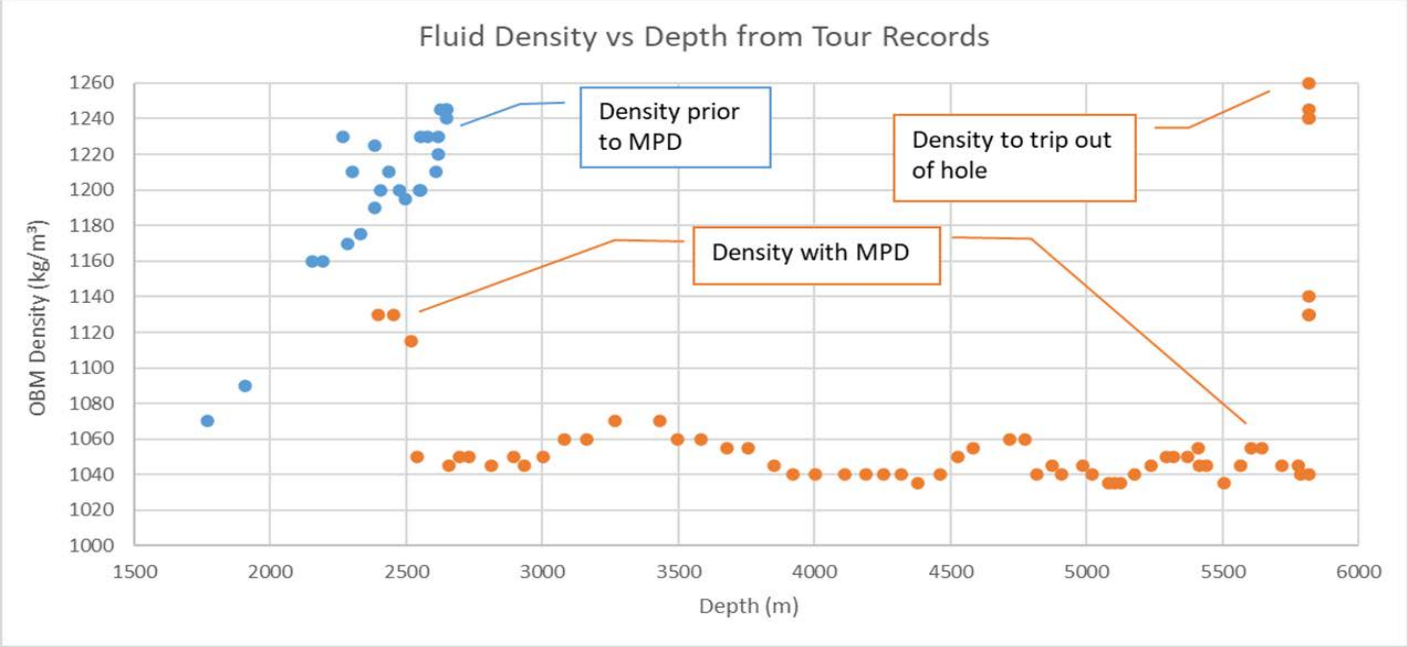

Figure 2: Fluid Density for Main Interval