**Case History**

**Drilling Optimization**

**Geo-Pilot® XL System and StrataSteer® 3D Geosteering Service Help Save US$ 812,000 in a Thin Sand Reservoir**

Location: Chermingat Field, Offshore Malaysia

**OPERATOR’S CHALLENGE** – Newfield Peninsula Malaysia Inc. required optimized wellbore placement in a 4 meter (13 feet) thick complex sand reservoir to help ensure maximum reservoir drainage.

**HALLIBURTON’S SOLUTION** – Sperry Drilling services deployed the Geo-Pilot® XL 9600/7600 series rotary steerable systems, ABG™ At-Bit Gamma sensor, triple-combo of logging-while-drilling (LWD) tools and StrataSteer® 3D geosteering service.

**ECONOMIC VALUE CREATED** – Improved drilling time for delivery of 500 meters (1,640 feet) of high quality reservoir saved an estimated US$ 812,000. Exposing the maximum interval of productive sand helped increase ultimate recovery.

**UNCERTAIN EARTH MODEL** – Newfield Peninsula Malaysia Inc. planned to drill horizontal wells in the Chermingat field located in the Malay basin offshore Trengganu, Malaysia. On oil producer Chermingat A02, they needed to penetrate the 4 meter (13 feet) thick J18 reservoir for maximum drainage of the production zone. Various methods and tool applications were reviewed to determine the best and most efficient way to deliver this well for oil production, as the thinner reservoir combined with uncertainty of the geological earth model presented significant challenges.

The pre-well calculations on torque and drag for the well plan indicated that a steerable motor drilling assembly would not be efficient, taking time to slide through to achieve the required dogleg, so a robust rotary steerable system was deemed necessary to drill the hole section. The point-the-bit Geo-Pilot XL rotary steerable system was considered well-suited to deliver the necessary dogleg while rotating and drilling ahead. The ability to rotate throughout the drilling section has the added advantage of better hole cleaning, stirring up the cuttings from the low side of the hole for the drilling mud to bring them to the surface.

**OPTIMUM WELBORE PLACEMENT** – The Geo-Pilot XL 9600 series rotary steerable system and ABG sensor (an at-bit gamma-ray imaging tool), in combination with the StrataSteer 3D geosteering service, were deployed to assist in delivering optimum wellbore placement in the thin J18 reservoir. For the horizontal entry point in the 12-1/4” hole section, the Geo-Pilot XL 9600 series system was paired with a triple-combo of LWD tools, consisting of DGR™ Dual Gamma Ray sensor, EWR™-PHASE 4™ Electromagnetic Wave Resistivity multiple depth of investigation sensor, CTN™ Compensated Thermal Neutron sensor, ALD™ Azimuthal LithoDensity sensor and Pressure-While-Drilling (PWD) wellbore pressure measurement sensor. The same suite of tools was used to drill and log the 12-1/4” pilot hole for data acquisition. The 8-1/2” horizontal section used the same tool types, except with 6-3/4” LWD tools and the Geo-Pilot XL 7600 series system.

Real-time at-bit gamma images one meter (3.3 feet) from the bit proved crucial in providing early structural interpretation for
geosteering decisions, further refined by the higher resolution density images. StrataSteer 3D geosteering service specialists, based in the customer’s office in Kuala Lumpur, provided the subsurface team with guidance throughout the geosteering process, helping with the successful delivery of the well objectives.

Advanced StrataSteer 3D geosteering software was used to create a geological model based on offset data and geological surfaces. This local geological model was continuously updated throughout the drilling process, based on the best match between modeled and actual LWD sensor responses, to reveal local bed dip, bed thickness and faults. Changes in the well trajectory were communicated to the rotary steerable system ‘on-the-fly’ by means of the Geo-Span® downlink service, which allows two-way downlinking, while on-bottom drilling ahead. This new level of efficiency, using at-bit images immediately integrated into an intuitive geological modeling package with full support from the geosteering advisors, resulted in rapid geosteering decisions with no downtime waiting for a decision from town. The team delivered 500 meters (1,640 feet) of high quality reservoir, meeting the objective of the original well plan.

COLLABORATIVE DECISION-MAKING YIELDS IMPROVED DRILLING TIME AND OPTIMIZED WELLBORE PLACEMENT – The operation of the StrataSteer 3D geosteering service from the Newfield office in Kuala Lumpur resulted in a high-end service that enabled collaborative decision-making. StrataSteer 3D service proved to be a valuable visualization tool combining earth model, well profile, and LWD data in real time. The flexibility of the software was crucial in the reworking of the model during the 8-1/2” hole section, which improved the quality of the real-time decisions. Combining this service with a Geo-Pilot XL rotary steerable system improved drilling time and helped save an estimated US$ 812,000. The initial well objectives were met with 500 meters (1,640 feet) of high quality reservoir intersected. The combined services also contributed to the significant high production oil rate from Chermingat A02, still the highest oil producer on the platform at this time.

The methodology, lessons learned, and experience gained from this well were applied successfully in the next drilling campaign in East Belumut A02 and in subsequent wells on the East Belumut platform.