A North Sea operator needed to plug and abandon (P&A) a well. The plan was to section mill 9¾-in casing in open hole. NORSOK regulations stipulate that a 165-ft (50-m) window for a cement plug is required for each hydrocarbon zone in the wellbore. To meet this regulation, two cement plugs were planned, one from 12,078 to 12,243 ft (3660 to 3710 m) measured depth (MD), and one from 13,140 to 13,305 ft (3982 to 4032 m) MD, with maximum inclinations of 76º and 83.5º, respectively.

The deeper window took two runs because the knives on the section mill wore out on the first run after milling 40.92 ft (12.4 m). On both of these runs, the only tool in the bottom-hole assembly (BHA) was an extended-reach section mill, without the benefit of a performance sub and with no way to monitor downhole operational parameters.

Due to mud losses, slow progress, loss of weight, high torque peaks (up to 40 kNm), and no indication of changes in the pressure when outside the window, the decision was made to pull the first BHA out of hole. A second extended-reach BHA was then run in hole to complete the deeper window.

For the shallower window, the solution was to use xSight™ smart intervention services to improve section milling efficiency by observing downhole data such as weight, torque, equivalent circulating density (ECD), vibration, and differential pressure in real time.

The BHA consisted of the standard section mill, the xSight downhole performance sub, and the xSight bi-directional power and communication module. By combining the standard section mill and xSight smart intervention services, the operator had better control of downhole operational parameters. Data-enabled optimization allowed the window to be cut and milled in a single run, saving a trip and about 24 hours of rig time.

Monitoring downhole pressure data (differential pressure) and ECD during the section milling was important in preventing kicks and losses. These two key parameters provided an early indication of debris packoff during the milling operation, allowing the operator to respond quickly, putting in practice corrective actions to mitigate the issue. By using the xSight downhole performance sub to monitor the

**Challenges**

- Deep section mill a 165-ft (50-m) window in 9¾-in. casing
- Section mill the window with maximum inclination of 76º inclination

**Results**

- Saved a full day of rig time
- Cut and section milled 148.50 ft (45 m) of 9-in. casing in an openhole wellbore
- Monitored ECD to reduce risk of mud loss and avoid debris packoff
- Maximized cuttings removal
measured differential pressures and ECD, it was possible to identify whether the packoff was taking place above or below the downhole performance sub. Other parameters monitored during the milling operations were downhole weight and torque. During the run, good weight transfer and downhole torque was observed, representing approximately 15-20% of the applied surface torque. There were low levels of lateral vibration most of the run, not requiring immediate action.

In all, reducing the section milling operation to a single run saved 14 hr of trip time, 6 hr of additional wellbore cleanup, and 4 hr for cleaning the blowout preventer.

xBHGE’s xSight™ smart intervention services enhanced the customer’s understanding of the forces acting on the BHA, enabling them to increase efficiency and save time with downhole operational data.