# Innovative Perf-and-Plug System

## Saves More Than $800,000 by Recovering OBM and Setting Environmental Plugs in 1 Trip

### Objectives

- Set an environmental plug without cutting and pulling or section milling casing to remediate annuli with trapped oil-based mud (OBM) in each of two wells.

### Our Approach

- The operator met with Weatherford to discuss two subsea abandonment operations in the southern North Sea. Each well had OBM trapped in the 9 5/8- × 13 3/8-in. annulus at the time of well construction. The proposed remediation plan for each well entailed cutting and pulling or section milling the 9 5/8- and 13 3/8-in. casing, circulating out the OBM, setting a bridge plug, and placing a cement plug in the main bore. Moreover, the cut-and-pull operations required a jackup rig equipped with a 13 5/8-in. blowout preventer (BOP) stack, and the BOP needed replacing with a larger 18 3/4-in. size, which increased risks associated with handling unfamiliar rig equipment.
- Weatherford suggested an innovative perf-and-plug system as an alternative method for significant cost savings. The system would enable recovering the OBM, remediating the annulus, and setting a mainbore plug in one trip. It should be noted that evidence of the 13 3/8- × 20-in. annular condition was provided and accepted. Weatherford could have remediated the 9 5/8- × 13 5/8-in. annulus and the 13 3/8- × 20-in. annulus with the same methodology described below, if it had been required.
- After careful planning, Weatherford presented the finalized plug-and-perf procedure, which the operator subsequently accepted.
- The Weatherford team deployed the system and performed the following tasks:
  - Perforated 24 ft (7.3 m) below the wellhead in the 9 5/8-in. casing and opened return circulation from the annulus requiring remediation.
  - Perforated below the subsea wellhead at a 1,520-ft (463.3-m) measured depth (MD).
  - Set the packer and straddled the lowermost perforation at 1,500 ft (457.2 m).
  - Circulated out the OBM with a surfactant spacer to water-wet the annulus in preparation for the cementing operation.
  - Pump cement into the annulus to form a 530-ft (161.5-m) column chased by a cement latch dart.
  - Disconnected from the straddle, which closed the ball valve on release.
  - Place a balanced cement plug on top of the straddle assembly in the main bore.
- In each well, the operations removed OBM from the annulus and set an environmental plug in a single trip, which left the well ready for the recovery of the high-pressure riser system and removal of the subsea wellhead without the risk of releasing unwanted fluids into the subsea environment.

### Value to Customer

- The unique Weatherford perf-and-plug system delivered an alternative solution that saved 2 days per well, or 4 days total, which equates to more than US $800,000 in rig time. The system also saved additional third-party costs for swarf handling and disposal by eliminating the need for section milling and cut-and-pull operations.

The image at the left shows a unique bottomhole assembly designed to remediate annuli with OBM in a cost-effective manner while preserving the offshore location.

**LOCATION**
United Kingdom, North Sea

**WELL TYPE**
Offshore, oil producer

**HOLE ANGLE**
36°

**CASING SIZE AND TYPE**
- 9 5/8-in., 53.5-lb/ft L80
- 13 3/8-in., 72-lb/ft L80

**LINER SIZE**
7 in., 29 lb/ft

**DEPTH**
9,405 ft (2,867 m) TD

**TOP OF LINER**
5,600 ft (1,707 m) MD

**PRODUCTS/SERVICES**
- Drillpipe wiper dart
- Ball abandonment valve
- Arrow set packer
- Bypass sub
- Perforated pup
- Drillpipe flapper valve and carrier
- SSR straddle plug

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