

# Innovative Well Design Delivers Best-in-Class Performance

FlexSTONE HT cements achieve zonal isolation for North Sea HPHT wells

## CHALLENGE

Deliver a sustained production rate from complex wells in a UK North Sea field by creating a permanent seal above a high-pressure, high-temperature (HPHT) formation.

## SOLUTION

The flexible nature and stability of the FlexSTONE HT\* cement system at high temperatures with additional design tools using CemSTRESS\* software helped to mitigate potential pressure accumulation problems.

## RESULTS

After two years of operation, the three wells had no production interruptions and showed no indications of zonal isolation failure.

**Compared to other North Sea HPHT developments, this field provided the first experience of simultaneous drilling and production with proven depletion levels up to 11 MPa [1,600 psi], and no well integrity issues disrupting production.**



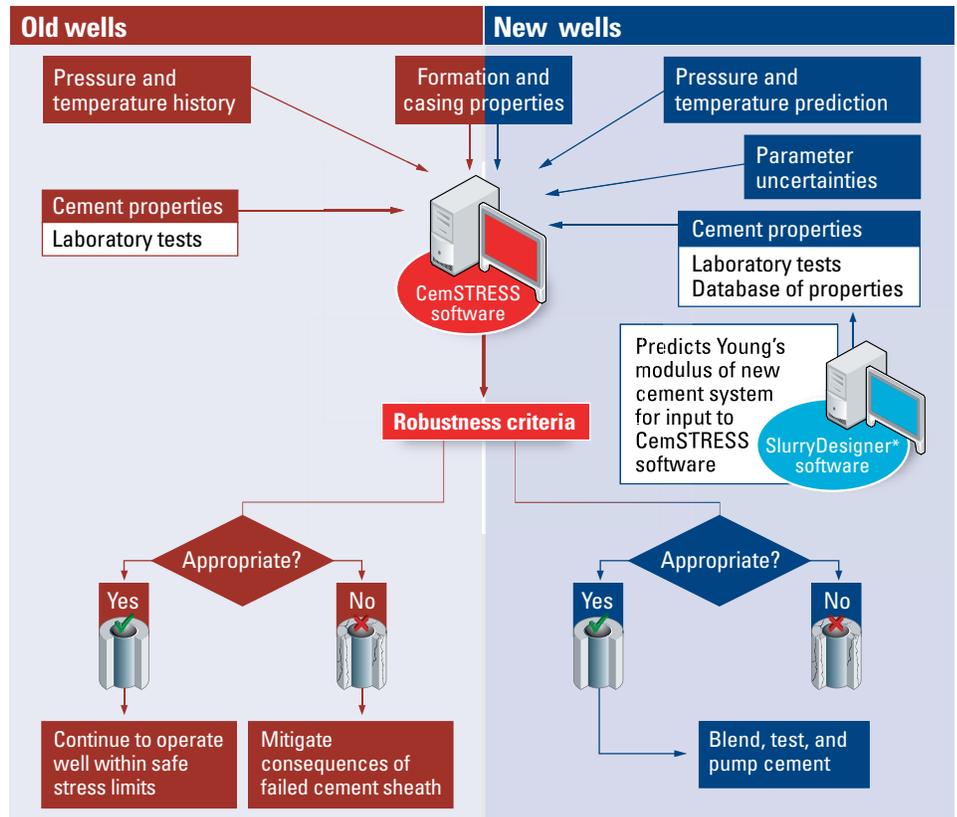
## Sustained production in wells with potential variable pressure

The operator's goal was to deliver a sustained 6.8 million m<sup>3</sup>/d [240 MMcf/d] production rate from three wells in a sandstone reservoir with a limited completion budget. This required a different approach to well design than typically used in other North Sea HPHT developments, where pressure accumulation on the previously cemented annulus has often been a problem.

The drilling team needed to find an application that would eliminate this potential for pressure accumulation, which could cause monitoring problems on a subsea well with undesired wellhead pressure or require costly subsea remedial treatments.

## Customized cements provide tight seal and improved well pressure control

The FlexSTONE HT advanced high-temperature flexible cement technology system was used to create a permanent seal above the HPHT formation. Schlumberger proposed using FlexSTONE HT cements because of their flexible nature and high temperature stability. CemSTRESS software provided additional design tools. Displacement modeling proved crucial to effective planning and execution.



For both new wells and wells that are being reworked, CemSTRESS cement sheath stress analysis software can model the mechanical performance of set cement under changing well conditions and predict needed set-cement properties.

## CASE STUDY: FlexSTONE HT cements achieve zonal isolation for North Sea HPHT wells

As designed, 305 m [1,000 ft] of 1,941 kg/m<sup>3</sup> [16.2 lbm/galUS] flexible FlexSTONE HT cement was placed across the interface of the high-pressure formation to effectively provide a gasket-like seal complete with expanding agent behind the production casing string. The inclusion of the expanding agent was designed as a mitigation measure against microannulus creation during casing pressure testing operations.

The operator also used a heavier FlexSTONE HT system to cement the HPHT production liner. This gave the needed control in the production zone and provided a tight-sealing flexible cement at temperatures up to 193 degC [380 degF].

Both FlexSTONE HT cemented strings were pressure-tested to 69 MPa [10,000 psi] and were subject to a drawdown test in excess of 41 MPa [6,000 psi] with no indications of a failed cement sheath.

### Cost-effective long-term zonal isolation for HPHT wells

The success of the HPHT cementation approach can be measured by the absence of any pressured B-annuli in 2 years of operation. Compared to other North Sea HPHT developments, this field provided the first experience of simultaneous drilling and production with proven depletion levels up to 11 MPa [1,600 psi], and no well integrity issues disrupting production. This design, which also remained under budget, was the basis upon which best-in-class drilling performance was achieved.



*Unique properties of flexibility and stability under HPHT conditions make FlexSTONE HT cements the right choice.*

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**Schlumberger**