

## Casing-in-Casing Cementing for Shale Gas Well Refracturing

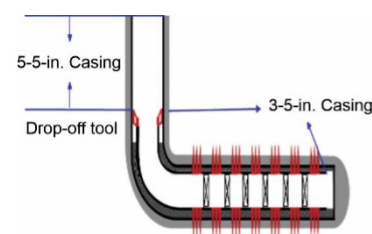
SHALECEM™ CEMENT SLURRY AND PROTECH™ II CASING CENTRALIZATION USED TO REACH TOTAL DEPTH AND ISOLATE ALL EXISTING PERFORATIONS

### OVERVIEW

The Fuling shale gas field is the first shale gas field in China. Early developed wells required refracturing to help improve gas recovery. The operator sought to deploy casing-in-casing (CiC) cementing refracturing methods for this operation. It was decided to run 3.5-in. semi-flush joint casing into the 5.5-in. existing casing to perform cementing operations. Following, a new 5.5- × 3.5-in. wellbore was reconstructed for a stage-fracturing operation.

### CHALLENGE

After years of production, the legacy wellbore experienced serious losses attributed to reservoir depletion and some wells exhibited casing integrity issues. The legacy wellbore is constructed of 5.5-in. production casing and the new inner string is 3.5-in. semi-flush casing. These losses and tight annulus tolerance made it challenging to achieve the desired TOC. Additionally, the narrow cement sheath of the annulus requires optimal mechanical properties to withstand completion fracturing pressure. Thus, centralizing the semi-flush casing in this narrow long horizontal section would prove challenging.



### CHALLENGE

- Reconstruct a new wellbore in a legacy wellbore with perforations and severe losses

### SOLUTION

- Deploy Protech™ II centralizers to semi-flush 3.5-in. joint casing with standoff above 70%
- Pump tailored, stable, low-rheology ShaleCem™ cement slurry with good mechanical properties

### RESULTS

- Successfully reached well TD
- Cement returned to the designed depth and old perforations were isolated
- New wellbore passed pressure testing and 21 stages of fracturing treatment were successfully executed in the first well

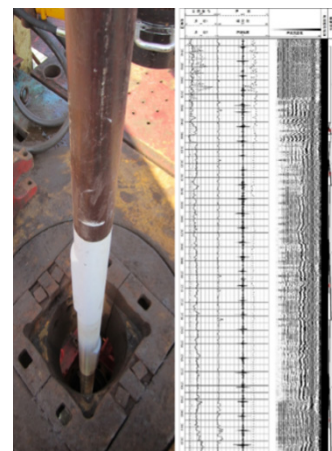
## SOLUTION

Drawing from a robust history with successful CiC operations in shale gas/oil wells globally, Halliburton recommended a combination of ShaleCem cement slurry technology and Protech casing centralization to achieve the operator's needs. A latex-based slurry with low rheology, low fluid loss, and good mechanical properties was used. Protech centralization was selected for the semi-flush joint casing to help reduce friction and achieve positive standoff.

This well has a 4.67-in. ID and float collar depth of 3978.7 m. The lateral section is 1198 m and TVD is 2691 m. There are 43 existing perforation slots in the lateral section of the well, starting from 2793 m. The new inner liner casing is 3.5 in. semi-flush joint casing pipe with 2.99-in. ID. Before running the inner casing, the wellbore was cleaned, and losses were treated to maintain pressure. Protech II centralization was designed with two sets of double straight blades per casing joint. On each set, the blades were installed with 180° offset. Each set was designed with 90° offset, resulting in 360° circumferential coverage while providing optimal bypass area to reduce the Equivalent Circulating Density (ECD). The OD of the casing with two blades is 4.41 in. The Protech II centralizers were installed on the casing from bottom to ~300 m above the top existing perforations. 9 m<sup>3</sup> of slurry with a density of 1.76 SG were pumped to return to the drop-off tool depth in the annulus. After the cement plug was bumped, the running string above the drop-off tool was pulled out.

## RESULTS

The inner casing string was run to bottom. Excellent cement bond log results were achieved and the TOC was near the designed depth. The new wellbore passed pressure testing at 85 MPa and 21 stages of fracturing were completed. A total of 31277 m<sup>3</sup> of fluid and 1840 tons of proppant were pumped. Four wells were executed by 2022 with good cement quality.



» (Left) running casing;  
(right) cementing log

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