Completion Strategy Based on Geomechanics Interpretation Boosts Gas Production to 1,844 m³/d

Petrotechnical evaluation helps GDF Suez regain original gas production rates with no operational shut-ins, North Sea

**CHALLENGE**
Regain economical gas production by controlling sand production in North Sea wells.

**SOLUTION**
Collaborate with Schlumberger petrotechnical experts to
- build a sand prediction model
- perform accurate sand-failure analysis using geomechanics modeling
- reengineer completions and production strategy based on analysis.

**RESULTS**
Designed and deployed optimal completion strategy to enable continuously producing at the original daily production rate of 1,844 m³/d (11,600 bbl/d of oil equivalent) with no operational shut-ins.

**Remediate two shut-in North Sea wells**
GDF Suez was producing four gas wells in the Netherlands sector of the North Sea. After five years of production, two of the wells—which accounted for 75% of total gas production in the field—began producing large volumes of sand. Workover and sand remediation techniques were unsuccessful, and the wells were eventually shut in and abandoned. GDF Suez sought a solution that would help regain economical gas production as well as maintain control over sand production for the service life of the wells.

**Better understand sand factors for optimal recompletion**
Schlumberger petrotechnical experts collaborated with GDF Suez to engineer and deploy an effective solution. The teams worked together to develop the following methodology:

1. Calibrate a geomechanical model to quantitatively represent the in situ stress and rock mechanical properties in multiple reservoir sections of the abandoned wells.
2. Perform rock mechanics laboratory testing on reservoir core to reduce the uncertainty in critical parameters and improve the accuracy of sand-failure analysis.
3. Develop a sand prediction model enabled by proprietary technology with inputs from the geomechanical model to hindcast the sand failure and production mechanisms observed in the field. This model would provide the basis to reengineer the wells.

The first phase of the projects included a geomechanical study of the reservoir sections of the abandoned wells. Then, rock mechanics laboratory testing was performed to quantify and evaluate rock strength and plasticity. Well measurements were used to calibrate the state of stress acting on the producing sections. Rock testing and well measurements enabled the Schlumberger petrotechnical team to accurately predict the sanding history of the two abandoned wells and identify the causes.

Modeling indicated that a thin sand layer with low rock strength was the main contributor to overall sand production. This conclusion was later validated with a downhole sand detector tool. The modeling also anticipated potential sand production from other stronger sections of the reservoir as the field continued to deplete.
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Due to severe sanding, two of the field’s four wells were shut in, reducing total gas production by 75%. Following sand prediction and remediation, production rates returned to the field’s previously highest levels free of sand.

Produce at original rates after intervention

Using innovative workflows enabled by software capabilities, the petrotechnical team constructed a validated prediction of sand failure for the reservoir and investigated improvements to the wells’ completion design that would give both economic production rates and sand-free production for the life of the field.

Geomechanics analysis defined a well trajectory through the reservoir that would produce with decreased sand instability. GDF Suez drilled a deviated sidetrack from one of the abandoned wells following this trajectory. The analysis, using the sand prediction model, provided GDF Suez with the means to determine the optimal screenless completion design, which involved selective and oriented perforating as well as individualized sizes and phasings of perforating charges that would achieve sand-free production.

To validate the sand prediction model, a downhole sand detection tool was run in Wells B1, B2, and B3, identifying zones that were producing sand, which matched well with the predicted zones.
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Sand failure analysis of the reservoir depended on constructing a mechanical earth model, calibrated at each step with laboratory tests, core data, and log data. Schlumberger petrotechnical experts used this model for sand prediction.

Interpretation of the sand prediction model results, coupled with advanced geomechanics evaluation, helped GDF Suez develop an optimized recompletion strategy for its remaining three wells. The strategy included removing previous completions and selectively reperforating intervals, running screens and gravel packs for sand control, and managing the production drawdown pressures according to the stability envelopes that were determined by the sand-failure model.

Since this remedial work was performed, the field has been producing without sand and has recovered the missed production. The wells were put back into service and produced at their original daily gas production rate of 1,844 m³/d without operational shut-ins caused by sand production.