Wintershall Holding GmbH, Germany’s largest crude oil and natural gas producer, was using a single realization of its geological and dynamic models to inform development-planning decisions for a gas condensate field. This did not allow for the full range of possible outcomes to be evaluated, limiting Wintershall’s visibility on potential risk factors and the accuracy of production forecasting.

Wintershall needed to better evaluate uncertainties during field-development planning to identify and mitigate risk, and generate more reliable production forecasts. After meeting with Schlumberger to discuss field-development and stimulation solutions, Wintershall decided on a fully stochastic analysis to help identify and mitigate the most significant risk factors.

An uncertainty study was planned to cover the entire range of parameters and possible outcomes, and inform future development plans. The Petrel E&P software platform would be used to generate static and dynamic reservoir models, with ECLIPSE® reservoir simulation software simulating crucial production scenarios.

**Reduced uncertainty**
Defining reasonable ranges for the parameter values was an important aspect of the analysis. Quantitative analysis was performed to evaluate the impact of individual uncertain parameters, such as gas production or reservoir pressure, which were then modeled as objective functions.
The compositional, full-field model featured eight hydrocarbon components over several hundred thousand active grid cells—including more than 100 hydraulically fractured wells. The model was calibrated against historical performance, including effects such as condensate banking and velocity stripping, and was used to predict various production scenarios. These scenarios were then optimized over all uncertain parameters.

The project was powered by a fully configured, 128-core high-performance computing (HPC) cluster, deployed in an optimum hosting environment. The HPC cluster used Intel Xeon X5672 processors with up to 96 GB of RAM per node. Interconnected InfiniBand was employed as required for parallel ECLIPSE calculations. The cluster was maintained at maximum performance by Schlumberger staff, who also supported remote access. All transferred data was encrypted and all data stored on the server was secured. Daily automatic backups ensured data safety.

The Petrel uncertainty optimization process established the impact of all uncertain parameters—geological or dynamic—using an objective function (e.g., recovery of gas reserves). It then converted the results into a proxy model that was optimized using Monte Carlo methodology.

**Results**
The resulting uncertainty analysis workflow enabled a combination of geologic and engineering variables to be evaluated, which was previously impossible. For the first time, the impact of geological parameters—such as absolute and relative permeability, and condensate gas ratios—were investigated and ranked. These variables were complemented by evaluating the impact of engineering parameters, such as varying fracture length, for a more coherent analysis of the factors that affect cumulative gas production. Wintershall was able to perform a comprehensive analysis of all uncertain parameters to improve production forecasting and field development planning.

E-mail sisinfo@slb.com or contact your local Schlumberger representative to learn more.

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