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**Challenges for recompleting old cavern wells
– insights on a practical project example**

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Challenges for recompleting old cavern wells – insights on a practical project example

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Abstract

Gas Storage Denmark (GSD) operates a storage facility with seven gas storage caverns at the Lille Torup site in northern Denmark. The caverns have been built in the 1980s and after almost 30 years of gas operation GSD considered the flooding and recompletion of the caverns at Lille Torup. The general project covers the flooding and recompletion operation of most of the caverns in the cavern field and was mainly motivated by safety reasons, i.e. installing state of the art equipment such as a surface controlled subsurface safety valve (SCSSV) and new sealing elements (packer) and replacing defective completion parts.

Due to a revoked discharge permit for brine it is currently not possible to flood the caverns using water from the nearby fjord, since the generated brine cannot be disposed afterwards. Therefore, the already existing brine within one of the caverns is being used as flooding medium. In 2019 a first brine / gas swap between the two caverns To-6 and To-7 was successfully performed. The brine filled cavern To-7 was then to be recompleted and refilled with gas. The hereby displaced brine was to be used for the next flooding and recompletion operation.

Contrary to the already flooded and recompleted caverns, the cavern To-7 contains a certain volume of the polymer Oppanol, which was initially injected during original cavern construction in the 1980's prior to gas operation. The Oppanol was intended to act as a sump sealing to reduce the water content in the stored and produced gas. Due to its physical properties, it had to be expected, that the Oppanol would be produced to surface at various stages of the upcoming operations. It was therefore considered to have an impact on the recompletion, gas refilling and snubbing operation as well as implementing of the new SCSSV.

The project started in September 2021. A series of testing, investigations and preparatory operations had been performed including subsurface measurements, sampling and laboratory analysis of the Oppanol and brine from the well, risk assessment of all operational working steps and actual production of the Oppanol, cleaning methods and well interventions. As main interest a series of measures were taken in order to prevent or reduce any contact of the new completion parts with the substance to prevent even slightest possible interferences.

In addition to the mentioned aspects and during the recompletion phase of the project, a section of noticeably increased ovalization was detected within the last cemented casing (LCC). An initial review raised the primary concern of whether the integrity of the well would be affected under operating conditions. A comprehensive evaluation was conducted under certain approaches to verify the integrity status of the well with respect to its gas storage operation.

The paper gives an overview of the planning process and findings from investigation or practical operations. The associated challenges and solutions are given and in particular, the operative methods are described.

Key words: Salt Caverns, Gas Storage, Recompletion, Well Intervention, Oppanol, Testing, Monitoring