

# Cluster cavern well drilling- advantages and limitations

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## 1 Abstract

Modern directional drilling technology with the use of downhole motors and MWD systems is also now being used to drill deviated cavern boreholes. Such boreholes are drilled radially out from a central position to the present well spacing in the casing shoe zone of the last cemented casing string (as determined by rock mechanical investigations). The separation on the surface is determined by the space required for workover rigs during the brining and storage phase.

Unlike oil and gas production wells, the cavern wells in the cavern zone must run vertically, which demands S-shaped directionally drilled wells. Because caverns are generally only drilled to a depth of around 2,000 m, building up the angle must start at a shallow depth, i.e. usually directly beneath the conductor pipe with bit sizes of 23" to 24". These large diameters constrain the permissible dogleg severity to 4 - 4.5°/30 m to ensure that there will be no problems in running in the stiff large diameter casing.

Cluster boreholes of the type described above make savings in wellpad and road space when compared to separate vertically drilled wells. Savings are also made in surface pipelines. From cluster well sites it is possible to explore geological interesting formations beneath protected areas, forests, rivers, levees etc.

It is important that cluster sites are only used in geologically well evaluated salt formations. However, partial recultivation in the event of a failed well is difficult, whereas single well sites can be completely recultivated. Another limitation is that the depth of cluster caverns is less variable than is the case with vertical boreholes. They can be drilled deeper but not structurally higher should unfavourable geology be encountered in the zone where the salt is expected. In this case such caverns will not achieve the predicted final geometrical volume.

The casing programs for directionally drilled wells must be planned especially carefully because uncased formations in the build up and build down zone can lead to the formation of key seats, especially in soft formations such as found in the Lower and Upper Cretaceous of Northern Germany.

In these zones difficulties can be encountered when running in, and especially, when running out the drill string, and can actually lead to drill string sticking -

with consequent expensive fishing and even potential loss of the borehole. Casing this zone of the overburden right through to the anhydrite cap before drilling into the salt formation avoids these problems.

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