

## Well and Storage Cavern Integrity Monitoring

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### Abstract

In caring for storage caverns, operators, engineers and service providers should be vigilantly monitoring each cavern. Carefully monitoring the integrity of the storage cavern's primary barrier typically incorporates multiple measurements.

There are typically no physical possibilities to enter the caverns and visually assess the condition of each critical aspect of the primary barrier. Therefore, integrity monitoring relies completely on high-quality measurement equipment and experienced personnel.

Over the years, significant development of measurement tools and firsthand experience has grown tremendously. As a practical result, measurement data is collected periodically, and the caverns are extensively evaluated. Throughout the storage operation, continuous monitoring includes measuring the temperature, pressure, cavern shape and volume.

Caverns are primarily monitored for convergence as this causes a loss in volume available for the storage medium. Integrity monitoring looks critically at entire shape or form of the completed cavern and assesses it for minor changes. This invariably refers to accurately measuring incremental changes in the wellbore's and cavern's dimensions and shape over time. Not only the cavern walls, roof and floor but also the neck, casing shoe area, wellbore casings and tubings are all included in the comprehensive evaluation of the integrity of a storage cavern.

If the roof and the neck of the cavern are to be controlled precisely to detect the development of fracs, fissures, delaminations, etc. at the early stages it is essential that these areas be accessible with borehole tools. Typically this should be performed with a sonar tool using tilted shots below the roof and with a high-resolution neck survey, which can measure distances as small as the tool's diameter. To make this possible any pipes in this region have to be pulled out of hole or as a minimum have to be lifted higher than the last cemented casing shoe. This is the only way that this sensitive area of the cavern can be seriously controlled.

Attached to the cavern and a critical part of the integrity is traditionally one wellbore. Cemented into the wellbore is the casing, which seals and prevents a possible loss of the storage medium into the surrounding formations. Integrity monitoring typically includes inspecting this cemented casing for possible loss of cement bond or corrosion development. There have been invariably recent discoveries over the operational lifespan of a cavern and wellbore that were not taken into consideration during the original design of older caverns. These were only observed through integrity monitoring. The critical area from the casing shoe to 50 meters above is problematic to adequately measure for integrity. Even though, it should not be neglected in the integrity monitoring.

**Key words:** Cavern Integrity, Sonar of Storage caverns, Cavern roof and cavern neck stability