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A Modern Approach to Assessing the Integrity of a Natural Gas Storage Cavern

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Abstract

Solution-mined salt caverns are commonly used to store natural gas underground in the US and throughout the world. Such caverns provide both large capacity and high rates of deliverability at an affordable price and are therefore a cost-effective option for gas storage operators. In the US, Mechanical Integrity Tests (MITs) are conducted periodically to ensure that caverns are tight and can safely store natural gas. MITs can be required by regulation or be a part of an operator's own integrity program.

The accuracy of an MIT depends on several factors, which include the volume of the test medium and the precision of the pressure and temperature measurements. For natural gas storage caverns, natural gas is typically the test medium. The massive quantity of gas in the cavern results in very poor test accuracy even with high-accuracy pressure and temperature data. In the past, the only feasible options for significantly increasing the MIT accuracy for a gas storage cavern has been to fill the cavern with water and conduct a standard nitrogen-brine interface test, which is typically both time and cost prohibitive.

Recent advances in and increased availability of wireline deployed optical fiber for distributed temperature sensing (DTS) has created a cost-effective alternative to standard wireline temperature logs used for integrity assessments of natural gas storage caverns. The DTS allows for the acquisition of a nearly continuous set of spatial and temporal data over the duration of a typical MIT. The large quantity of data obtained with DTS permits implementing modern statistical analyses that may increase the accuracy of well integrity assessments and improve analysis of transient temperature phenomena in wellbores and caverns.

This paper provides a brief overview of the typical US gas cavern MIT together with the proposed approach for determining the leak rate and the associated accuracy using statistical analysis with DTS temperature data.