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# Innovative Mechanical Integrity Tests for Solution-mined Caverns Using Distributed Temperature Sensing (DTS) Technology

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**Abstract**

Estimating the calculated nitrogen leakage rate (CNLR) has been a great challenge in Mechanical Integrity tests (MIT) for underground solution-mined storage caverns due to the lack of sufficient borewell measurements. In addition, the use of traditional temperature logging system for detecting gas leakage relies on the existence of steady state temperature conditions, which is difficult to validate with current measurement technologies. In this paper, a new measurement method, known as distributed temperature sensing (DTS) is introduced. The method relies on continuous measurements of real–time temperature data throughout the borewell to estimate the leakage rate. New mathematical formulation for the new DTS measurement technology is established to allow incorporating temperature measurements in estimating the CNLR. To observe the efficiency of the new method, a computational fluid dynamic (CFD) model for a real borewell was developed and various leakage scenarios were simulated and analyzed. The CFD simulations and analysis show the ability of the new DTS measurement coupled with the new mathematical formulation to accurately predict the leakage rates in both unsteady and steady state temperature conditions.

**Key words:** MIT (mechanical integrity test), calculated nitrogen leakage rate (CNLR), solution-mined storage caverns, computational fluid dynamics (CFD), distributed temperature sensing (DTS)