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PERSPECTIVES ON WELLBORE INTEGRITY TESTING: A FIELD STUDY TO EVALUATE MINIMUM DETECTABLE LEAK RATE IN GAS CAVERNS USING ULTRASOUND SURVEY

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Abstract

Regulatory agencies often require integrity test of natural gas caverns and associated components. In most cases, the validity of any cavern integrity test rests on the direct assessment of the wellbore assembly. However, the in-service configuration of most cavern wells in the U.S. allow for a debrining or hanging string inside cemented casing to maximize operational flexibility during debrining, production or injection activities. These hanging strings rule out the effective use of ultrasonic or magnetic source tools for direct assessment of cavern strings.

Nevertheless, a topical review of existing cavern, logging, and completion literature reveal little about the methods and techniques used to validate cavern wellbore integrity when ultrasonic sources are used in gas-filled caverns commissioned without a debrining string. In this study, a wellbore integrity test was performed on a gas cavern with no debrining string, drawing from procedures patterned after the pressure monitoring test but with pressure, temperature and ultrasonic noise response measurements. The initial wellhead pressure and temperature on the well (Hiltpold #3) at the time of the test were 2,398 psig and 77.6^{o}F respectively. A reference baseline (for background noise) was established with a test configuration created to simulate a casing leak, with flow rates, pressure drops, and ultrasound responses measured from the wellhead of an actual gas cavern. The measured data was used to develop a minimum detectable leak rate (MDLR) regression model. Thereafter, the ultrasonic noise log baseline response was compared to gas cavern response while shut-in to affirm cavern integrity. The result showed that the ultrasonic noise log could detect an approximate minimum leak rate of 50 Mcf/d at a differential pressure of 75 psi.

Key words: Ultrasonic, Mechanical, Integrity Test, Wellbore, Minimum Detectable Leak Rate, MDLR, Storage, Cavern, Logging, Ultrasound, Regression Model, Hanging String, Markham, Monitoring

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