ABSTRACT

This paper provides the results of a field-scale application conducted to demonstrate the use of continuum damage mechanics to determine the minimum allowable operating pressure of compressed natural gas storage caverns in salt formations. A geomechanical study was performed of two natural gas storage caverns (one existing and one planned) utilizing state-of-the-art salt mechanics to assess the potential for cavern instability and collapse. The geomechanical study consisted primarily of laboratory testing, theoretical development, and analytical/numerical tasks.

Fifty laboratory tests were performed on salt specimens to aid in the development and definition of the material model used to predict the behavior of rock salt. Material model refinement was performed to improve the predictive capability of modeling salt surrounding caverns during natural gas storage operation. Specifically, improvements were made to predict the healing of damaged salt, the creep of work-hardened salt during recovery, and the behavior of salt at stress states other than triaxial compression. Results of this study showed that the working gas capacity of the existing cavern could be increased by 18 percent and the planned cavern could be increased by 8 percent using the proposed method compared to a conventional stress-based method.

Keywords: Caverns for Gas Storage, Computer Modeling, Rock Mechanics, Salt Damage, Laboratory Testing