Solution Mining Research Institute Spring 2021 Virtual Technical Conference

19–22 April 2021

Stress Analysis of a Production Casing for a Cavern Developed Beneath an Existing Cavern Field

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Abstract

Storage cavern development in salt domes has been ongoing for many decades; as a result, locations for new cavern development are diminishing. With many existing caverns already reaching the end of their useful life and many others quickly approaching the end, the demand for cavern storage is projected to increase. These combined factors present challenges for storage facilities, operators, and industry at large. One potential solution is to develop new caverns beneath the horizon of the existing cavern field; however, this approach presents its own set of challenges to cavern development and operation, including the necessity to locate production casings in relatively close proximity to existing storage caverns. The potential for creep closure of the existing caverns to cause damage to the cemented casing in the nearby well raises concerns for well integrity and operational service life for any new caverns developed below the existing cavern field.

The objective of this research paper is to analyze the scenario of developing a new cavern beneath an existing cavern field and the casing stresses caused by creep closure of the nearby caverns. A geomechanical study was performed using numerical modeling and analytical methods to predict casing deformation and conduct a three-dimensional stress analysis of the new production casing. The study considered stresses associated with the predicted salt creep deformation as well as stresses associated with the weight of the casing and cavern operating fluid conditions. Based on the modeling results and casing stress analysis, several design and front-end analysis considerations are discussed for the successful development of new caverns below an existing cavern field.

Keywords: Cavern Development, Caverns for Liquid Storage, Computer Modeling, Well Casing, Salt Domes, Storage Cavern

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