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Meeting Paper

Geomechanical Evaluation of Sabine Gas Transmission Company's Cavern No. 2 at Spindel Top Salt Dome

by

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1.0 INTRODUCTION

1.1 BACKGROUND

Sabine Gas Transmission Company (SGT) operates two gas storage caverns at the Spindletop Salt Dome located near Beaumont, Texas. Leaching, gas inventory, gas/brine interface, and other operational data have been collected since the drilling of these wells. SGT desired to establish a lower minimum operating pressure and to evaluate expected closure rates due to creep for various operating scenarios. For this study SGT Cavern No. 2 was used to address these issues. This cavern was selected since it has the longest operating history and the longest history with down hole P-T (Pressure-Temperature) probes.

Vertical cross-sections for SGT Cavern No. 1 and No. 2 are shown on Figures 1-1 and 1-2, respectively. The overall geometries of both caverns are similar. They differ mainly in roof configuration. The SGT Cavern No. 1 is about 100 feet shallower, which should reduce the potential for micro-cracking/failure and creep closure slightly. The more flat final roof and the more asymmetrical cavern geometry of SGT Cavern No. 1 probably offset this factor. Since SGT Cavern No. 1 is very similar to SGT Cavern No. 2, the conclusions reached by this study are believed to also be apply to SGT Cavern No. 1.

Leaching of SGT Cavern No. 2 commenced on April 22, 1992 and de-watering was started on March 1, 1994. De-watering was finished on July 4, 1994 and the cavern was placed in service on July 13, 1994. The final volume was 4.1 MMbbls based on the final sonar survey. The well for the cavern was directionally drilled so as to avoid potential drilling problems due to previous sulphur mining in the caprock directly above the cavern location. The casing shoe is offset from the surface location 672 feet on a bearing of 200.34° from north. The casing shoe is at 4,051 feet TVD (4,114 feet MD) and the cavern roof is at about 4,127 feet TVD. The well was drilled to a total depth of 5,084 feet TVD with the top of the debris (mostly anhydrite sand) located at 4,782 feet TVD. Cores were obtained from 4,095–4,124 feet TVD and from 4,673–4,702 feet TVD. The maximum operating pressure for the cavern is 3,050 psig at the surface (3,355 psig at the casing shoe) and the minimum operating pressure was initially set at 1,200 psig at the surface (1,325 psig at the casing shoe).

The minimum operating pressure should be established to avoid or minimize near surface micro-cracking/failure in the salt. Micro-cracking can over time lead to slabbing of the cavern walls and/or roof falls. Generally, slabbing and/or roof falls are associated with excessive volume closure due to creep which in most cases is a result of either too low a minimum pressure or staying near the minimum pressure too long. Operating guidelines may be established to minimize volume closure due to creep.

A geomechanics analysis of the SGT Cavern No. 2 was performed to provide quantitative estimates of the potential for salt damage/failure at the lower operating pressure and the expected cavern closure due to creep. Mechanical

property data obtained from salt cores were used as input for the finite element modeling. The predictions of the finite element modeling were checked to the extent possible by comparing predicted cavern volumes over time with cavern volumes calculated from field data.