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Interbed modeling to predict wellbore damage for big hill strategic petroleum reserve

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Oil leaks were found in wellbores of Caverns 105 and 109 at the Big Hill Strategic Petroleum Reserve site. According to the field observations, two instances of casing damage occurred at the depth of the interbed between the caprock bottom and salt top. A three dimensional finite element model, which allows each cavern to be configured individually, was constructed to investigate horizontal and vertical displacements in each well as it crosses the various interbeds. The model contains interfaces between each lithology and a shear zone (fault) to examine the interbed behavior in a realistic manner. This analysis results indicate that the casings of Caverns 105 and 109 failed, respectively,from shear stress that exceeded the casing shear strength due to the horizontal movement of the salt top relative to the caprock and tensile stress due to the downward movement of the salt top from the caprock. The wellbores of Caverns 114 and 104, located at the far end of the field and near the fault, respectively, are predicted to fail by shear stress in the near future. The wellbores of inmostCaverns 107 and 108 are predicted to fail by tensile stress in the near future. The salt top subsides because the volumes of caverns in the salt dome decrease with time due to salt creep closure, while the caprock does not subside at the same rate as the salt top because the caprock is thick and stiff. This discrepancy yields deformation of well.

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