Three Dimensional Modeling of the Big Hill Strategic Petroleum Reserve Site, Texas

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ABSTRACT

A comprehensive, three-dimensional model of the Big Hill Salt Dome, Texas, including the U.S. Department of Energy Strategic Petroleum Reserve (SPR) Big Hill site, has been developed using available geological and geophysical data. The model is an integrated interpretation of regionally extensive gravity data, high resolution 2-D and 3-D seismic surveys, well-control data, and sonar data of the SPR oil storage caverns.

The model was constructed using an iterative methodology that involves matching the computed gravitational response of a geometric model consisting of three major rock types of differing densities — salt, caprock, and sediments — with the actual Bouguer gravity field of the earth. Construction of the initial geometric/density model, as well as adjustments to that initial model during successive iterations of the modeled gravity response, was constrained by a geologic framework based on the available well control and the 2-D and 3-D seismic interpretations. The resulting 3-D model of the Big Hill salt dome is an interpretation that honors essentially all of the data available, subject to professional evaluation of the uncertainties associated with those data.

One purpose of this work was to evaluate the potential storage capacity of the northwest portion of the Big Hill dome for possible expansion of the SPR Big Hill facility. The total volume of the Big Hill salt dome has been redefined to a depth of about 20,000 feet, based principally on the iterative gravity modeling. The redefined total volume is markedly less than initial interpretations based solely on well control and seismic data. The total volume of salt may be as much as 36 percent less than estimated earlier. Most of this volume reduction takes place below the depths of interest to the SPR program. However, a reduction in salt volume of as much as18 percent may affect the prime SPR oil-storage interval between depths of 2,000 and 5,000 ft. A secondary purpose of this work was to demonstrate the capabilities of current 3-D computer modeling and graphical visualization techniques to characterize an SPR site.

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