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Technical Conference Paper

CAVERN WELL CONVERSION TO FIBER OPTIC STRAIN MONITORING WELL

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Abstract

As a first-of-its-kind for the Strategic Petroleum Reserve (SPR), the U.S. Department of Energy (DOE) has installed a fiber optic cable in Cavern Well BH105B at the Big Hill (BH) Site. Fluor Federal Petroleum Operations (FFPO), the Management and Operating contractor to DOE, worked in consultation with Sandia National Laboratories, to complete the conversion workover pursuant to a permit issued by the Railroad Commission of Texas under Statewide Rule 95(p)(2), Alternative Monitoring.

Multiple wells at the BH Site have exhibited casing deformation at the salt-caprock interface depth at about 1,650 ft (503 m), and Well BH105B is the most severe case of casing deformation to date. In 2011, this well was remediated due to deformation by installing a 10-3/4" cemented liner inside a 13-3/8'' production casing. During a diagnostic workover in 2020, the 8-5/8" hanging string showed deformation at the salt-caprock interface due to impingement by the 10-3/4" cemented liner. The hanging string was removed, and a plug was set near the 13-3/8'' production casing shoe to isolate the well from the cavern. A subsequent downhole video appeared to show a crack in the 10-3/4" liner at the salt-caprock interface. The severity of the deformation led to the decision to take the well out of storage service. Cavern BH105 had been operated as a two-well storage cavern for almost 40 years and will now be operated as a single-well storage cavern.

A 2-7/8" x 7" tapered completion string was used to convey the fiber into the well with the crossover landing just above the deformation depth. The fiber optic cable was secured with protectors to the completion string as it was run into the well. Once landed, the string was cemented in place and included monitoring the fiber optic cable for Distributed Strain Sensing (DSS) and Distributed Acoustic Sensing (DAS) data during the cement operation. A baseline DSS interrogation was acquired one week after final cementing. Thereafter, spot (1-day) and multi-day DSS interrogations will assess changes in strain at the salt-caprock interface depth.

The installed wellbore fiber optic cable is unique in two respects; first, the overall diameter of the DSS component is 1/8" diameter instead of 1/4" diameter; and second, the cable configuration is a flatpack consisting of one DSS fiber and support member on the one half and a tubing encapsulated fiber (TEF) component dressed with two multi-mode (MMF) and three single-mode (SMF) fibers on the opposite half. A temperature and pressure gauge (PT) is connected to a single-mode fiber and mounted at the shoe joint of the completion string.

The DSS data will be used to model the loads experienced by the casings at the depth of the deformation. The DSS data will be studied with the goal of maximizing the useful life of existing and future cavern storage wells by proper construction and remediation of wells in the Big Hill salt dome. Monitoring will continue as long as the system remains viable. After this, the well will be permanently plugged and abandoned.

Key words: Fiber optic well, optical fiber, DTS, DSS, strain monitoring, wellbore casing deformation, instrumentation and monitoring, alternative wellbore monitoring, Strategic Petroleum Reserve (SPR).

**Fluor Federal Petroleum Operations (FFPO) is a special-purpose company formed for the sole purpose of managing and operating the Strategic Petroleum Reserve (SPR) under a prime contract with the U.S. Department of Energy (DOE). This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.*