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THE UTILITY OF SONARS AND THE SANSMIC LEACHING CODE FOR MONITORING CAVERN SHAPE DEVELOPMENT DURING THE RECENT UNPRECEDENTED OIL VOLUME MOVEMENTS AT THE SPR

Todd R. Zeitler, David B. Hart
Sandia National Laboratories, Albuquerque, New Mexico, United States

Abstract

The Strategic Petroleum Reserve (SPR) has experienced unprecedented oil volume movements over the past few years, including contributions due to sales, exchanges for storage, and Congressional and Presidential drawdowns. The use of raw water injections to remove oil from the SPR caverns results in leaching of the salt cavern walls which leads to the development of additional ullage in these caverns while also changing their shapes. The use of sonars and leaching models to monitor the recent impacts of leaching across caverns at all four SPR sites is the focus of this paper.

The use of sonars provides the most direct measure of cavern shape and growth but comes with some limitations. The sonars used at the SPR sites produce three-dimensional representations of the caverns primarily based on 10-20 ft vertical resolution and a ~1-3% uncertainty on horizontal measurements. Sonars are typically performed on SPR caverns every 5-10 years by state regulations. However, with the increased extent of leaching taking place in SPR caverns, an increased number of sonars have been performed as a monitoring step. For caverns where recent sonars are not available and substantial raw water injections have occurred, modeling of the cavern development due to leaching has proved to be a useful monitoring tool.

The Sandia Solution Mining Code (SANSMIC) has been used to predict cavern leaching in SPR caverns using standard salt dissolution models that account for the salinity of the injected water. Simulations use sonar-derived cavern shapes and raw water injection histories to project cavern growth. The results derived from this modeling tool are shown to be in good general agreement with sonar data. However, the SANSMIC code has its own limitations with respect to predicting cavern shapes, such as the need for an axisymmetric (rather than full 360°) cavern representation, inheritance of the uncertainty inherent in the sonars, and lack of process models for creep and floor rise.

The utility of sonars and the SANSMIC tool for monitoring cavern shape development during the recent unprecedented oil volume movements at the SPR will be shown via recent examples where partial and full drawdowns of SPR caverns have occurred.

Keywords: leaching, salt dissolution, model uncertainty, sonar