SOLUTION MINING RESEARCH INSTITUTE

New address as of June, 1995:

1745 Chris Court
Deerfield, Illinois 60015-2079

Country code: 1 ♦ Voice: 847-374-0490
Fax: 847-374-0491 ♦ E-mail: bdiamond@mcs.com

MEETING PAPER

Mechanical Behavior of Sealed SPR Caverns

by

B.L. Ehgartner and J.K. Linn
Sandia National Laboratories, Albuquerque, NM

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ABSTRACT

It is inevitable that sealing and abandonment will someday occur in a U.S. Strategic Petroleum Reserve (SPR) cavern or caverns. To gain insight into the long-term behavior of a typical SPR cavern following sealing and abandonment, a suite of finite element analyses were performed. The analyses predict how quickly and to what extent a cavern pressurizes after it is plugged. The analyses examine the stability of the cavern as it changes shape due to the increased pressures generated after plugging. Internal fluid pressures in a brine filled cavern eventually exceed lithostatic pressure in the upper portion of the cavern resulting in enlargement and stress reduction. The buildup of fluid pressure after plugging is largely determined by salt creep, salt dissolution, and geothermal heating of brine. Volumetric closure due to creep increases brine pressure. Salt dissolution and geothermal heating occur when the brine is unsaturated and cooler than the surrounding salt at the time of plugging. The individual and coupled effects of creep, dissolution, and geothermal heating are modeled. The analyses suggest that the predicted rate and magnitude of fluid pressurization in SPR caverns is not high enough to result in fracturing of the salt. However, cavern pressure can be substantially mitigated by delaying plugging until the brine has come closer to thermal equilibrium.

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