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Technical Conference Paper

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OBSERVATIONS AND EXPERISNCE LEARNED FROM REMEDIATION TO PREVENT COLLAPSE OF I&W BRINE CAVITY IN CARLSBAD, NEW MEXICO

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Abstract

Remediation of the I&W Brine Cavity in Carlsbad, New Mexico has been completed. The I&W brine production facility adjacent to Federal Highway 285, the Carlsbad Irrigation District Canal, and adjacent lots, removed an estimated 220,000 cubic yards (CY, 168,200 m^3) of halite from the Salado Formation during solutioning operations lasting from 1979 to 2008. The facility operated as a single well system, then as a two-well system from 1980 to 1999, and as a single well system from 2000 to 2008. Depth to top of halite was about 456 feet (139 m). Collapse of similarly shallow brine production facilities at Loco Hills and Jim's Water Services north of Carlsbad in 2008 prompted closure of the I&W facility in 2008 with realization that unknown conditions and potential for collapse of the underlying brine cavity presented a significant hazard to the public and surrounding critical infrastructure.

An initial real-time instrumentation monitoring system was installed. This included four ultrahigh resolution borehole tiltmeters (BTMs) and weather parameters. A downhole sonar survey through the facility wellhead mapped 3% of the anticipated void volume. Brine release during cavity entry resulted in BTM response showing ground movement tilting toward the cavity until the well was shut in. Wellhead brine pressure was added to the monitoring program, and wellhead brine pressure eventually rose to 65 psi. To prevent uncontrolled cavity depressurization resulting in possible cavity collapse, drilling near or into the cavity for characterization was not permitted before rehabilitation. A microseismic monitoring network was installed outside the interpreted zone of impacted halite through boreholes that also provided nearby geologic characterization. Cavity evaluations were performed primarily using surface geophysical methods, synthesis of available information, and analyses. A detailed Feasibility Study was completed in 2014 (AMEC 2014). It was followed by technical review, and the process of publicly funding a remediation program.

A brine cavity remediation program was developed, approved, funded, and executed. Based on feasibility study results, the volume of potentially impacted halite formation had been mapped and estimated to be about three times the volume of halite removed by solutioning. Therefore, brine cavity space was assumed to be essentially filled with rubble under a horizon of roof rock spanning limited open void space. A strategy of high mobility grouting (HMG) at the cavity perimeter immediately under the roof rock to buttress the roof rock span support was developed. After an enhanced monitoring system was installed and operational, this strategy was implemented. HMG at the brine cavity southern half was completed. As the operation moved northward, a grout hole encountered a 64-foot void in the formation above the halite. A second grout hole encountered a larger void, which indicated partial collapse of the northern cavity area, which was confirmed by downhole sonar. A new remediation strategy of sand backfilling the void using slurried sand was developed. Many technical issues were encountered and resolved before approximately 175,000 CY of slurried sand backfill finally filled the cavity. Post-remediation monitoring is in process to assess current and predict future behavior of the filled cavity.

Key words: brine well, brine cavity, remediation, sand slurry, high mobility grout, monitoring