Well Integrity Assurance for Sub-Salt and Near-Salt Deepwater GoM Reservoirs

J. T. Fredrich[1], D. D. Coblentz[1], A. F. Fossum[2], B. J. Thorne[1] (1) Sandia National Laboratories, Albuquerque, NM (2) Sandia National Laboratories, Albuquerque,

The deepwater Gulf of Mexico (GoM) is the most active deepwater region in the world and provides some of the greatest challenges in scope and opportunity for the industry. The complex salt tectonics and extreme depths necessitate high development costs and require innovative technology to bring these fields on stream. Integral to the economics is a well lifetime of 15-30 years.

This paper presents research conducted under a JIP funded by the DOE and an industry consortium and focused on assuring the long-term integrity of sub-salt and near-salt wells under producing conditions. Non-linear finite element geomechanical modeling at reservoir and wellbore scales is performed to analyze the perturbed stress state adjacent to salt bodies and to evaluate salt loading on casings over the well lifetime, respectively. The reservoir-scale modeling reveals that, at certain locations for specific geometries, shear stresses are amplified, horizontal and vertical stresses are perturbed, principal stresses are reoriented, and horizontal stress differences occur. The reservoir-scale modeling enables more rigorous planning of well paths to avoid areas of potential geomechanical instability, and provides more accurate estimates of vertical and horizontal stresses around and within salt bodies for wellbore stability analyses. The wellbore-scale analyses reveal the critical role of hole quality in affecting loading due to salt creep and the role of cement in mitigating adverse loading situations. The wellbore-scale analyses have been utilized in casing design programs for two of the five largest oil fields ever discovered in the deepwater GoM, resulting in cost savings of over $30M.