GMP01

Integration of Geological & Coupled 3D Geomechanical Modeling to Evaluate Gas Injection Risk - A Due Diligence Study Prior to iWAG Injection Development

D J Press* (Schlumberger) & P.C. Mei (Talisman)

SUMMARY

When considering field development utilizing EOR techniques it is important that the changes in stress than any EOR methodology will bring about are correctly forecasted and understood. Associated changes in formation stresses due to field operations may lead to undesirable conditions such as loss of shale seal integrity or fault reactivation if not properly analysed and controlled.

As part of the development planning for revitalization of a mature field offshore Malaysia, iWAG scheme was proposed. As the field and overburden contained a considerable number of faults, an assessment of the injection gas migration was required. Any loss of shale seal or fault reactivation during the iWAG operations may lead to the development of gas migration pathways to the seabed and giving rise to a risk to the platform installations.

A risk evaluation study was carried out to assess the injection gas migration from the reservoir to the seabed. This hazard was identified as a principal HSE risk to the platform installations.

A workflow was constructed which involved the integration of geological and petrophysical seal evaluations with coupled fluid-stress geomechanical modeling of the depletion and injection processes to determine reservoir seal efficiency and gas leakage risks due to hydraulic fracturing and/or fault reactivation.
When considering field development utilizing EOR techniques it is important that the changes in stress than any EOR methodology will bring about are correctly forecasted and understood. Associated changes in formation stresses due to field operations may lead to undesirable conditions such as loss of shale seal integrity or fault reactivation if not properly analysed and controlled.

As part of the development planning for revitalization of a mature field offshore Malaysia, an alternating water and gas (iWAG) scheme was proposed. As the field and overburden contained a considerable number of faults, an assessment of the likelihood of injection gas migration was required. Any loss of shale seal or fault reactivation during the iWAG operations may lead to the development of associated gas migration pathways to the seabed and giving rise to a risk to the platform installations.

For the field in question, a risk evaluation study was carried out to assess the likelihood of injection gas migration from the reservoir to the seabed. This hazard was identified as a principal HSE risk to the platform installations by the Bokor Field contractors.

A work flow was constructed which involved the integration of geological and petrophysical based seal evaluations with coupled fluid-stress geomechanical modeling of the depletion and injection processes over the life of the field to determine reservoir shale seal efficiency and gas leakage risks due to hydraulic fracturing and/or fault reactivation. The coupled geomechanical modeling process incorporated, not only the resulting pressure changes arising due to depletion and injection within the reservoir, but also utilized a consolidation scheme to model the imposed pore pressure changes within the overburden arising due to stress transfer, and the subsequent dissipation of, these excess pore pressures with time.

Evidence of fault related gas migration in the geological past is seen by the presence of a shallow gas cloud identified on seismic data sitting above the crest of the structure. The scope of the study included the evaluation of this cloud on various vintages of seismic from 1976 to 2011, to determine whether the size and geometry of the gas cloud was related to previous field development. The study clearly demonstrates the application of coupled geomechanical modeling in assessing surface and subsurface risks resulting from field development.