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**Meeting Paper**

# A Few Applications of the Utilization of a 3-D Geomechanical Code for Underground Storage Cavern Design and Stability Studies

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# A few applications of the utilisation of a 3D geomechanical code for underground storage cavern design and stability studies

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Underground gas storage in geologically complex salt structures along with the optimisation of existing storage sites induced the need for geomechanical studies based on 3D simulations. The geomechanical code GEO3D has been developed by Gaz de France and the Geotechnics and Mining Department of the Paris School of Mines for this purpose and is now used for solving a wide range of geomechanical problems related to underground storage.

GEO3D is a software package based on the finite element method, using the initial stress method, which breaks into a linear elastic problem all mechanical situations where either finite transformations (solved by a succession of small time steps and geometry updates), or irreversibilities (viscosity or plasticity) occur. Using GEO3D, displacements, strains and stresses within 2D or 3D structures can be computed assuming any given loading history for materials involving elastic, elastoplastic, viscoplastic as well as elastoviscoplastic behaviors.

Usually geometrical studies related to salt creep and using finite element simulations are carried out in two dimensions, the modelled domain being a cross section through the actual geometry. In this paper, the results shown emphasize some three dimensional aspects that need to be accounted for from a geomechanical point of view when designing or studying the stability of salt caverns. Lemaître's elastoviscoplastic law is used by Gaz de France to describe rock salt's behavior.

Two dimensional studies require further hypotheses when modelling natural gas storage caverns, for instance either a single cavern or a hexagonal cavern network can be studied due to the axisymmetry of the problem. In this paper we describe two case studies where using a three dimensional code for axisymmetrical cavern shapes is useful. The simulations were run based on the parameters of Gaz de France's salt cavern storage site of Etrez, regarding the depth and shape of the modelled caverns, as well as the mechanical behavior of the salt.