France, Champs sur Marne - Thursday, March 28, 2013

# PhD position in Geomechanics

## Cyclic Fatigue of Rock Salt applied to the long term behaviour of salt caverns for Compressed Air Energy Storage

Thermo-hydro-mechanical phenomena occurring in deep rocks meet an increasing scientific interest because of their numerous applications to industrial problems such as underground storage of radioactive waste, $CO_2$, oil and gas and, more recently, compressed air energy storage (CAES). Indeed, the intermittent availability of renewable energies raises the question of their storage. A very promising storage method, at least for wind energy is the storage of compressed air in underground caverns. This technique, already used in some countries would enable to obtain large storage capacity with a relatively low cost. Major research projects are ongoing on this technique in several European countries.

The Compressed Air Energy Storage (CAES) poses specific problems of rock mechanics as a result of ranges of pressure and temperature involved. But especially the cyclical type of loading (frequent storage-release cycles) raises specific fatigue problems. Fatigue due to cyclic loading occurring potentially in the salt rock around the cavern has not been studied well and is poorly known in general for other rocks. It poses significant and specific risks to the sustainability of salt caverns in addition to the risks due to more conventional phenomena such as cracking, damage, creep and physicochemical deterioration of rocks. The thesis focuses on the study and numerical modelling of all these phenomena around underground openings in geological formations used for compressed air storage.

A numerical modelling is mainly achieved in this thesis that will rely on the available data in the literature or on simple physical models of the involved phenomena. These data are being completed quickly by many experimental works in progress in different research institutes around the world. Numerical modelling undertaken in this thesis will be aimed to, first, determine the stress cycles experienced by the viscoplastic rock in the near-field of storage under the cyclic mechanical and thermal loads. Then the material's fatigue under this cyclic loading will be studied as well as its effect on the long-term stability of the opening. The objective is to identify the most critical phenomena affecting the durability of the structure and thus determining the optimum cycles for engineering applications.

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