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679 Plank Road  
Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587  
[www.solutionmining.org](http://www.solutionmining.org)

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## **Fast multicyclic storage of hydrogen in salt caverns**

**Matthias Brandt<sup>1</sup> Tobias Fabig<sup>1</sup>**

<sup>1</sup> IfG - Institute for Geomechanics, Leipzig, Germany

**Eddy Kuperus<sup>2</sup>, Jeroen Dirven<sup>2</sup>**

<sup>2</sup> Nederlandse Gasunie N.V, Groningen, The Netherlands

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## **Fast multicyclic storage of hydrogen in salt caverns**

Matthias Brandt, Tobias Fabig

Institut für Gebirgsmechanik GmbH, Friederikenstraße 60, 04279 Leipzig, Germany

Eddy Kuperus, Jeroen Dirven

Nederlandse Gasunie N.V, Groningen, The Netherlands

### **Abstract**

In general gas storage in rock salt caverns is a proven technology, and multicyclic use of gas storage caverns has been applied for over a decade. In addition to natural gas, the change of the energy system will likely result in the need to store hydrogen in underground caverns on a large scale. In recent years, the fraction of high frequency multi-cyclic operation mode has considerably increased, where more frequent loading and unloading cycles per year are applied. To establish the long-term conditions in which the caverns can be safely operated, a methodology has been developed based on rock-mechanical assessments on both cavern stability and the integrity of the barrier-forming salt rock mass. This methodology has been applied for over a decade in various gas storage projects.

The presented work is based on the above-mentioned methodology and includes over one decade of measured operational data for the cyclic storage of natural gas, and the same data is adapted to the storage of hydrogen in terms of the different thermodynamic properties. Additional worst-case considerations are carried out to confirm geo-mechanical stability and tightness under all possible usage cases.

The methodology provides:

- The proof of integrity shows that the tightness and stability of the rock salt around a hydrogen cavern is maintained even for the considered worst case scenarios.
- Moreover, the assessment proves that migration of gas along the casing of the borehole to the overburden can be excluded as the necessary horizontal confining stress is larger than the acting gas pressure inside the casing.
- Plastic deformations along the cavern contour are minimal. Under realistic operation conditions, cavern convergence remains limited, resulting only in limited subsidence.

**Key words:** gas storage, caverns for gas storage, cavern operation, rock mechanics, computer modeling