SOLUTION MINING RESEARCH INSTITUTE

679 Plank Road
Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587
www.solutionmining.org

Technical Conference Paper

H2 Cavern Storage Transition (H2CAST) Etzel – Conversion of existing caverns for hydrogen storage

Stefan Kürzel

DEEP.KBB GmbH, Hanover, Germany

Sabine Donadei

DEEP.KBB GmbH, Hanover, Germany

Carsten Reekers

STORAG ETZEL GmbH, Friedeburg, Germany

Eddy Kuperus

Gasunie Energy Development GmbH, Groningen, The Netherlands

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Stefan Kürzel
DEEP.KBB GmbH, Hanover, Germany

Sabine Donadei
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Carsten Reekers
STORAG ETZEL GmbH, Friedeburg, Germany

Eddy Kuperus
N. V. Nederlandse Gasunie, Groningen, The Netherlands

Abstract

The H2CAST Etzel project is intended to demonstrate the convertibility of existing caverns and facilities in Etzel, Germany, for the storage of hydrogen as an essential element for a future energy system.

STORAG ETZEL GmbH, Gasunie Energy Development GmbH, DEEP.KBB GmbH, Institute of Networked Energy Systems, German Aerospace Center (DLR), HARTMANN Valves GmbH, SOCON Sonar Control Kavernenvermessung GmbH as well as Chair of Geomechanics and Multi-Physical Systems, Clausthal University of Technology, are consortium partners of this project. The project is funded by the Lower Saxony state government and the Federal Ministry for Economic Affairs and Climate Action of Germany.

Hydrogen storage operations will be tested and both subsurface and surface facilities are planned, constructed and included in the operations tests. Special features of the project are the closed Brine-Hydrogen-System with two caverns, which allows the performing of all relevant scenarios in regular operation by balancing brine and hydrogen without any loss of both media, the conversion of existing caverns with expected accumulation of hydrocarbons and possibly other accompanying substances, the surface installation to remove water vapor and hydrocarbon -and potentially sulfur contaminations from the hydrogen and the transfer of the cavern to regular hydrogen operation at the end of the project.

The project scope comprises all steps related to cavern conversion such as: tightness tests, hydrogen completion, hydrogen storage and operation, hydrogen purification, borehole integrity, retrofitting, cavern condition assessments, tests execution and evaluations, overall system modelling, modes of operation, energetic overall system assessment, valve technology, material suitability, maintenance, investigations and verification of storage integrity and tightness of the salt rock, rock mechanics and stability and measurement technology and related equipment. Moreover it includes testing the efficiency and operability of different (combinations of) hydrogen processing technologies like active carbon, TSA and glycol drying under realistic storage operating conditions.

The project addresses and answers the key questions related to repurposing existing caverns. This paper emphasizes the importance of the following questions for convertibility and presents approaches to answering them:

- Will and to what extend is the quality of the hydrogen affected when repurposing a former oil or gas storage cavern for hydrogen storage and what is the efficiency of hydrogen treatment processes to obtain hydrogen specifications?
- Which existing elements of a cavern can be (re)used for hydrogen and which should be specially designed for hydrogen?
- Will there be differences by testing the integrity of the caverns with nitrogen and hydrogen?

Further topics which are also addressed in this project and may be presented at a later date are:

- Hydrogen-specific issues during the permit approval process
- Demonstration of impermeability level for rock salt to hydrogen
- Differences for the preparation of the rock mechanical expert opinion for the storage of hydrogen compared to natural gas
- Influence of hydrogen as a storage medium on well integrity
- Loads occurring on the gas production pipe during hydrogen operation
- Challenges for sonar measurements in hydrogen storage caverns
- Check/Demonstration on the market availability of all required elements and services
- Efficiency, operability and applicability of different hydrogen purification processes in multi-cyclic cavern operation
- Requirements / Guideline for approvals.

Key words: H2CAST, Hydrogen Storage, Cavern Storage, Repurposing, Conversion, Hydrogen