

Development and Application of an Operator-Customized Storage Integrity Guideline

Dr. Olaf Kruck, Dr. Dirk Zander-Schiebenhöfer and Birgit Horváth,
KBB Underground Technologies, Hanover, Germany

Andreas Acht,
DEEP Underground Engineering, Bad Zwischenahn, Germany

Abstract

Salt caverns have been utilized for storing fluids for several decades in several countries. Conscientious operators have performed measures to maintain the integrity and functionality of the caverns already within the past decades. Hence, the increasing attention to maintain a safe storage operation is not new to the cavern industry. However, documentation of the considerations and planning steps as well as monitoring and maintenance measures regarding the storages in terms of their integrity have been identified to be subject for improvement. Therefore, the documentation of the procedures merged in a management system and the assessment of the overall storage integrity should be a main focus of operators. Furthermore, such implementation will meet the general idea of permitting authorities and state-of-the-art industry-standards to pursue an integrated approach.

In 2016 a paper on the “Systematic Approach for Storage Integrity Assessment of Existing Cavern Storages” was presented on the SMRI Fall Conference, which did propose several measures to assess the cavern integrity by Zander et al. [11]. In the meantime this approach has been developed towards the concept of an operator customized Storage Integrity Guideline, which will be documented in this paper. It will illustrate the combination of interdisciplinary interaction in terms of:

- Rock Mechanics,
- Cavern Operation and Thermodynamics,
- Geology and Solution Mining,
- Well and Completion Design and
- Maintenance.

The guideline was practically utilised in cooperation with a German operator, in regard to his storage wells. It combines the existing internal policies of the operator and his operational experience with relevant specifications of integrity relevant U.S. and European standards and regulations such as:

- DIN EN ISO 16530-1:2016-02 Petroleum and natural gas industries - Well integrity - Part 1: Life cycle governance [3],
- DIN EN ISO 16530-2:2016-05 Petroleum and natural gas industries - Well integrity - Part 2: Well integrity for the operational phase [4],
- BVEG Technical Rule Well Integrity [10],
- NORSOK D-010; Well integrity in drilling and well operations [8],
- API Recommended Practice 1171 Functional Integrity of Natural Gas Storage in Depleted Reservoirs and Aquifer Reservoirs [1].

In the next step, the guideline will be applied on existing storage caverns of this operator, to assess their initial integrity status. Additionally, this will serve as a basis for a periodic check of the well status. Deviations between the defined requirements and the established guideline will be analysed in a risk assessment in order to prioritize potentially required measures and interventions.

The paper will describe the structure and development of this operator-specific guideline as well as its planned implementation, by performing the initial integrity evaluation of the storage wells. Furthermore, it will give an outlook on the next steps regarding the conversion into a digital Storage Management System to simplify or automate a large part of the operators work in regard to storage operation as well as planning of maintenance, interventions, authority engineering, etc.

Key words: Storage Integrity, Cavern Integrity, Well Integrity, Guideline, Integrity Evaluation, Integrity Assessment, Risk Assessment, Management System