The Newsletter

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ASSET INTEGRITY MANAGEMENT:
WHEN A VISUALIZATION TOOLS IMPROVES SAFETY AND PERFORMANCE OPTIMIZATION

by Vincent Barrère

FOUR WAYS TO STORE LARGE QUANTITIES OF HYDROGEN

by Louis Londe

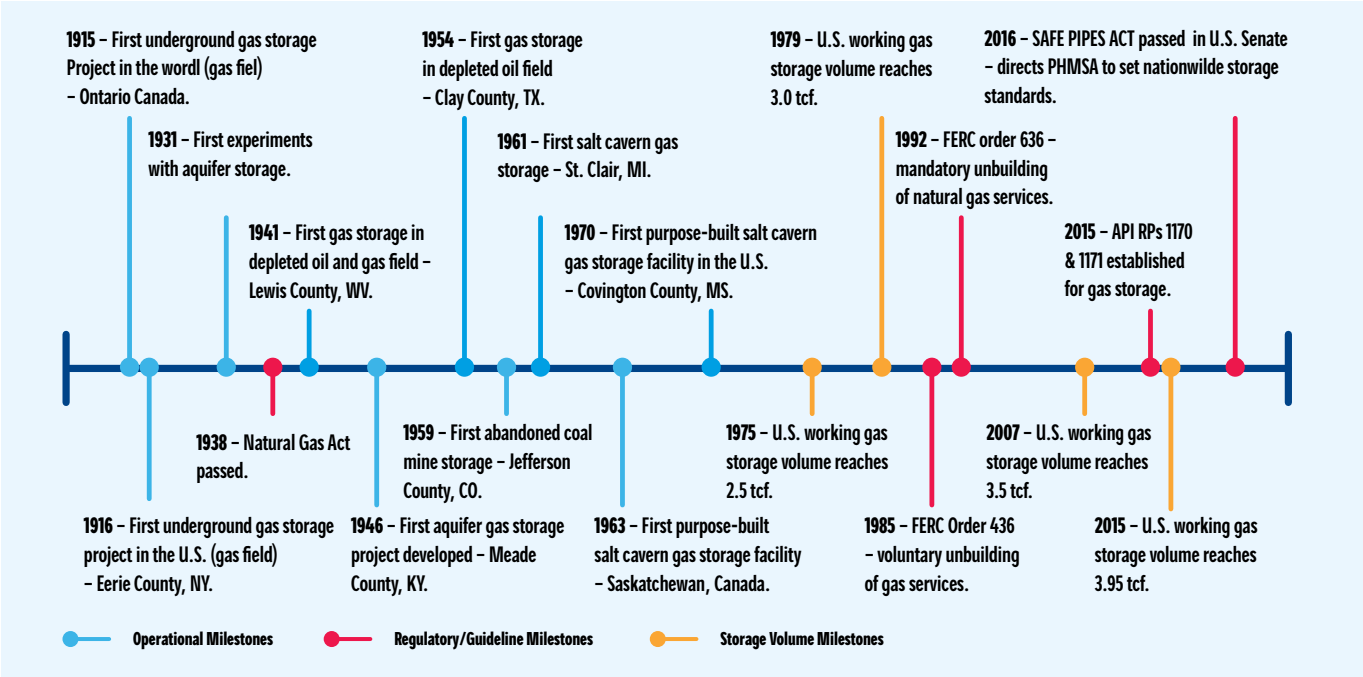
Geostock

Asset integrity management: when a visualization tools improves safety and performance optimization

An adaptable, visual and user-friendly interface: this is the new tool Geostock is implementing to support operators in managing their asset.

Vincent Barrère, *Solution mining Engineer, Geostock*

Nowadays, the vast majority of underground storage wells in the world are over 30 years-old. In a more and more competitive market environment, owners want to make the best out of their storage assets, as well as justifying their good condition and compliance with regards to more stringent and evolving regulations as illustrated by the figure below related to gas market in North-America.

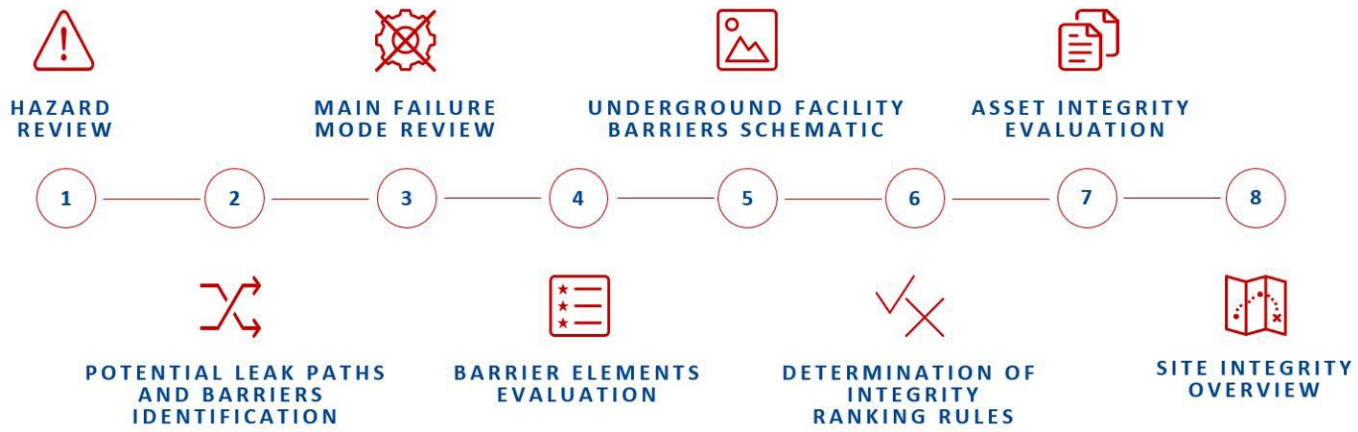


Timeline of Gas Market in North-America

GEOSTOCK has always accompanied storage operators in the evaluation and management of the integrity of their underground facilities through various ways:

- Operations supervision and advanced technical studies (cased hole logging / sonar surveys),
- Audit and gap filling analysis of existing integrity procedures,
- Partial to full implementation of an integrity management system of a storage site (AIMS).

This AIMS (Asset Integrity Management System) organizes the information and assesses the integrity of the barrier elements of underground facilities throughout their entire life span. GEOSTOCK has developed a unique methodology to set up such a system dedicated to underground storage, by adapting existing standards from the oil and gas industry (in particular the ISO/TS 16350 norm related to well integrity and life cycle governance) to the underground storage industry.

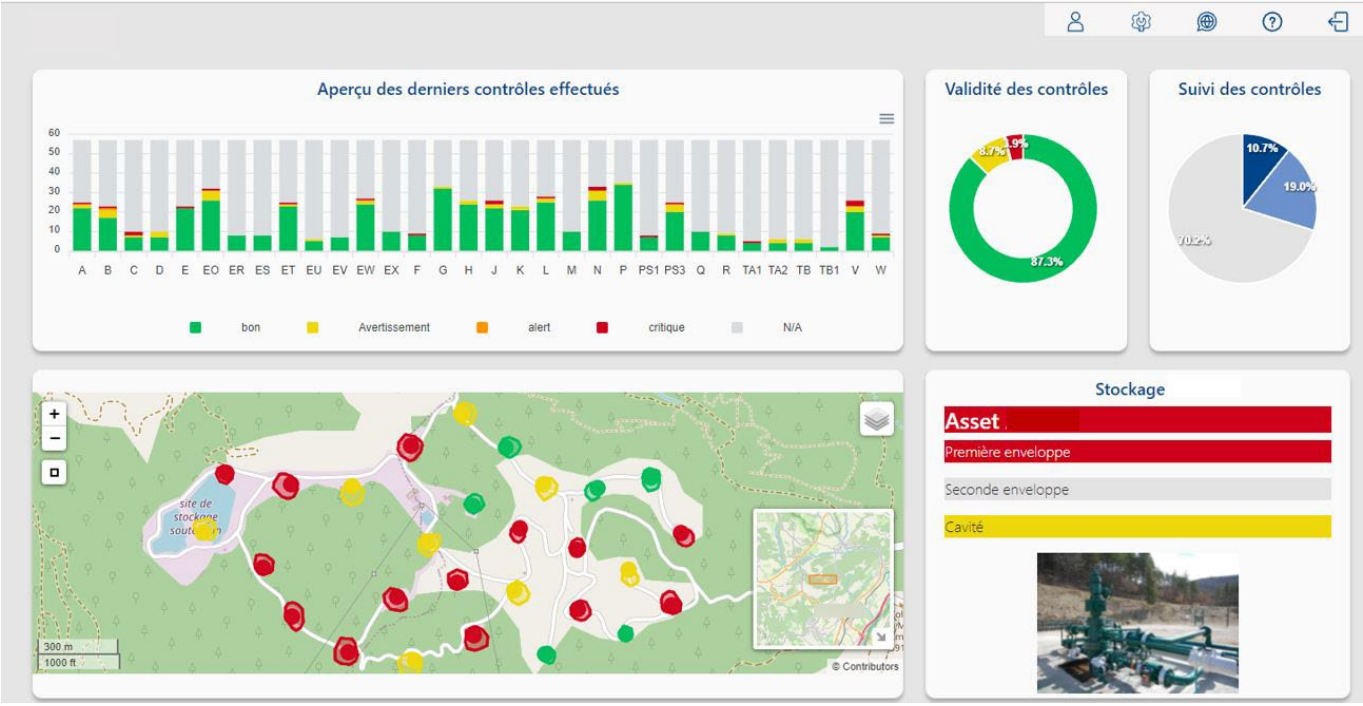


Integrity Assessment Typical Implementation

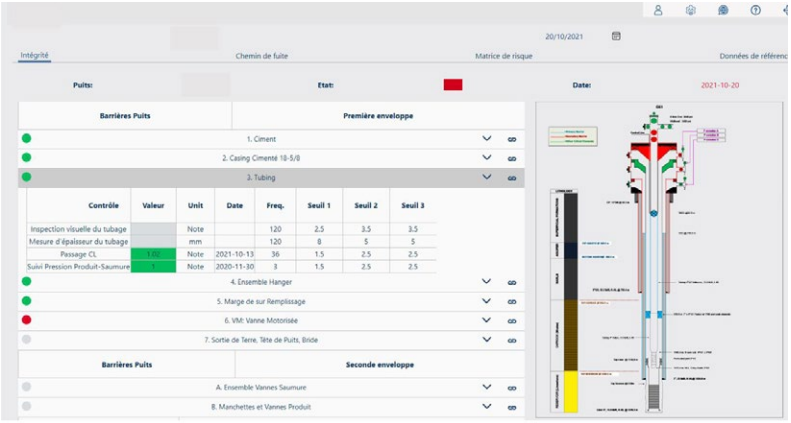
This approach benefits from GEOSTOCK's experience in France and worldwide, based on an engineering and operational synergy, and enables to efficiently address subsurface assets integrity management issues under the dual perspective of optimized safety and performance.

To provide operators a user-friendly way to apply this methodology, a in-house management tool has been developed, composed of a structured database paired to a visualization tool.

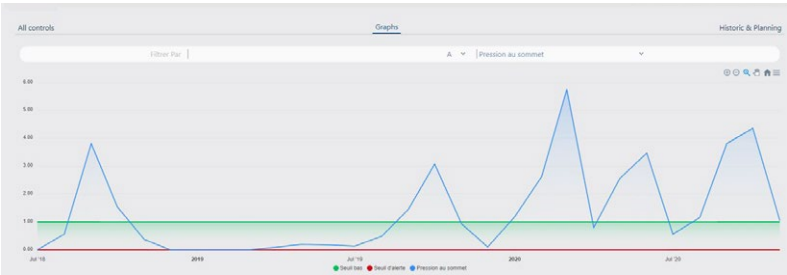
This latter consolidates and treats different operational site data to dynamically evaluate the integrity status of underground facilities components. The following functionalities are displayed:



- Asset Integrity Assessment: Well barrier Schematics, Risk Matrix, Leak Paths Diagrams, with an ease of access to relevant technical reports;



- Graphs, tables and chronological timeline to access to the controls history, analyze the evolution of the different integrity parameters, and provide assistance to schedule the next inspections.



- Module to assist the user in the management of anomalies observed when evaluating the integrity of the asset;

- Data import / Export module

- Key Performance Indicators and geographical mapping of the site facilities with their corresponding integrity status.

All those features comply with requirements in terms of quality control, traceability and documentation of the displayed data, which facilitates reviews and access to relevant information.

Hydrogen storage in a pressurized lined rock cavern (LRC)

The modular design of the application allows to fit the needs and specificities of each site (number of wells/ storage, type of storage, integrity criteria and corresponding thresholds, etc…), and to manage the users rights to connect to the different features of the tool.

This digital application :

- improves the collaborative exchange of information between the different parties involved (technical operators, stakeholders, third party companies, administration, etc…),
- provides a tailored solution to follow-up the integrity of an underground storage site,
- is a powerful device to technically justify and communicate in complete transparency on the status of the asset.

DID YOU KNOW?

- First gas storages to be built have been operating for more than 100 years.
- Worldwide underground gas storage working gas capacity has been doubled between 1970 and 1990 and increased fourfold between 1970 and 2016.
- In 2017 there were 672 facilities of gas storage worldwide .
- Wellbore integrity can be traced as the main factor in leakage in 46% of UGS depleted oil and gas fields, 38% of UGS in salt, and 19% of UGS in aquifers for which leaks have been reported.

Four ways to store large quantities of hydrogen

Hydrogen has been identified as an energy carrier that could play a major role in decarbonisation, and green hydrogen is seen as a possible substitute to fossil fuels. Developing a hydrogen economy will require storage capacities. Underground storage is a convincing solution for fulfilling extensive storage needs: various methods exist from the easiest to the most challenging.

Hydrogen can be stored in underground caverns or geological structures in one of four ways.

The easiest way to store hydrogen is in salt caverns (Figure 1). These are created by injecting fresh water or water with low salt content into a well down to a salt geological layer, with the extraction of salt-saturated brine. The caverns measure between 50 and 100 metres in diameter and up to several hundred meters tall where the salt formation is thick enough. Salt caverns are not lined, as the salt itself acts as a sealant. This type of storage is suitable for storing hydrogen at extremely high pressures where the salt layer is deep enough.

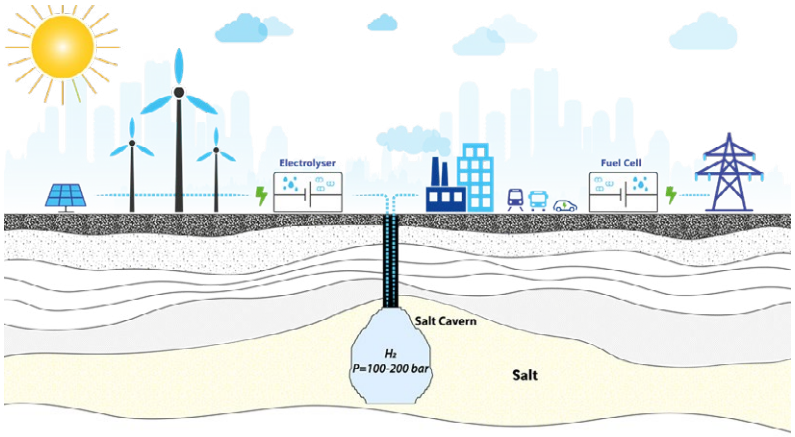


Figure 1: Hydrogen storage in salt cavern

The second way to store large quantities of hydrogen is to inject pure hydrogen or a hydrogen-methane mix into porous rock, in a depleted oil or gas field, or an aquifer (Figure 2). The hydrogen content may vary from a few per cent to 100 per cent. Reservoir and biochemical testing/modelling are to be performed accordingly. The hydrogen-methane mix can be withdrawn and injected into the network. Alternatively, hydrogen can be separated from methane at the well head, for example using pressure swing adsorption technology. ● ● ●

Louis Londe, *Technical Director, Geostock*

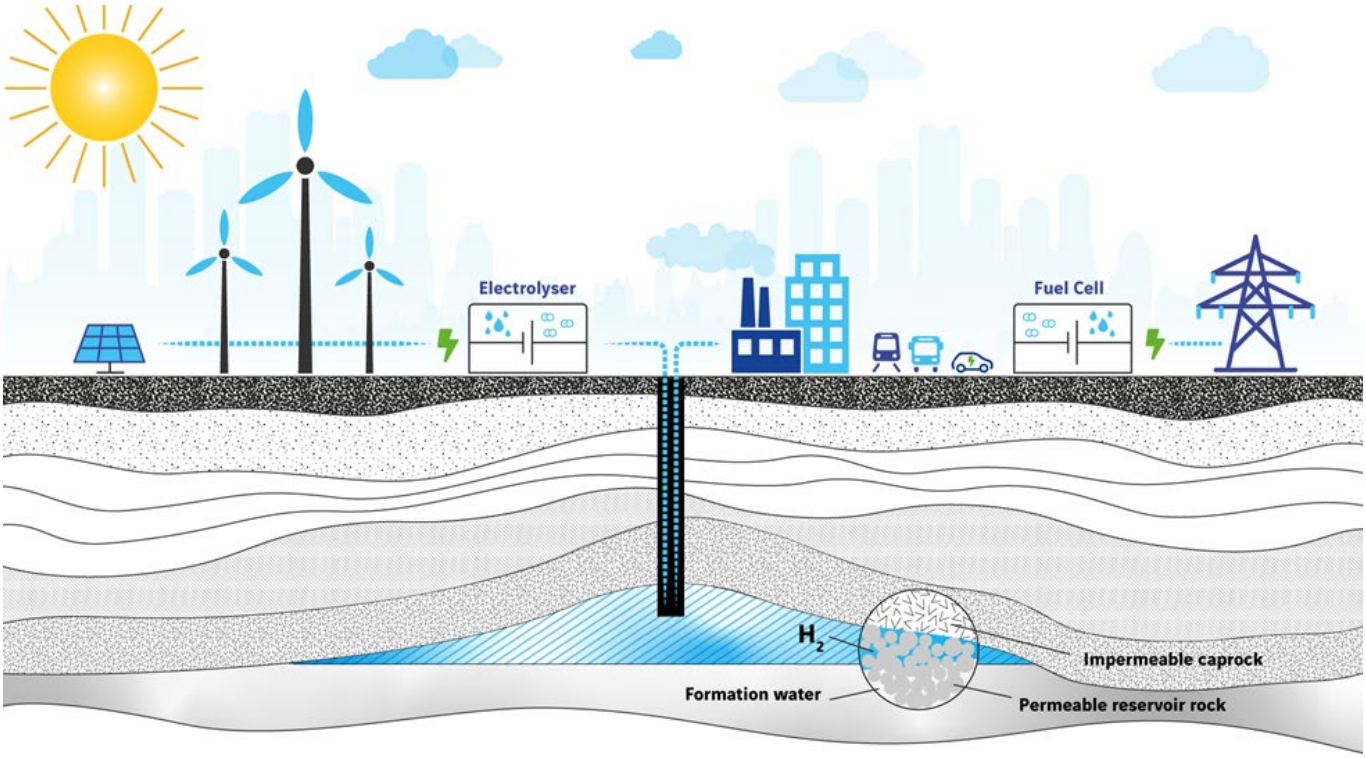


Figure 2: hydrogen storage in porous rock (Courtesy Hystories)

Hydrogen can also be stored underground by converting it into a liquid carrier, such as ammonia (Figure 3), which can then be stored in a Lined Rock Cavern. A liner is generally required to prevent contact between ammonia and water. The pressure and temperature are adapted to optimise the entire supply chain. The advantage of using ammonia is that proper storage conditions can be fulfilled without the need for excessive pressure or temperature.

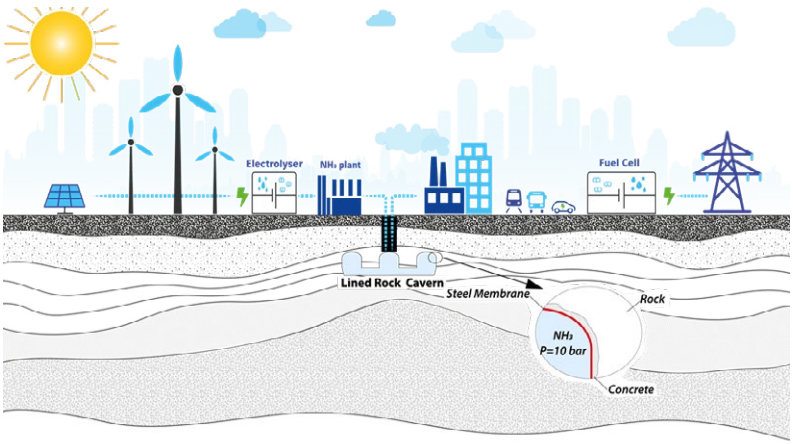


Figure 3: Lined Rock Cavern for ammonia storage

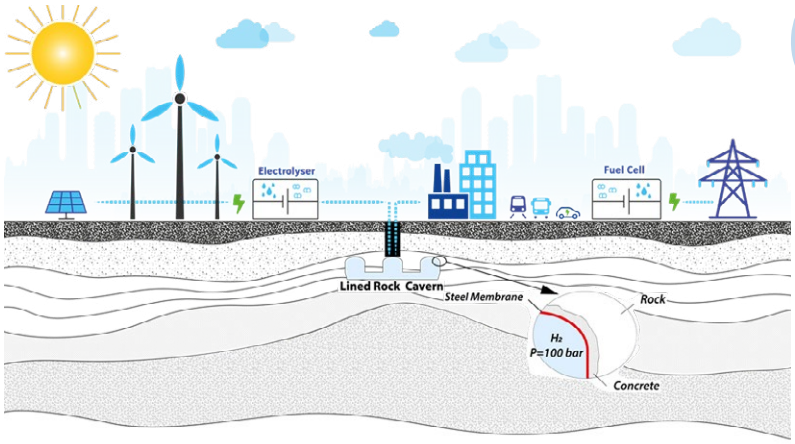


Figure 4: Hydrogen storage in a pressurized lined rock cavern (LRC)

Lastly, hydrogen can be stored underground by directly injecting it into a Lined Rock Cavern. This may take the form of compressed storage (gaseous hydrogen) or cryogenic storage (liquid hydrogen), the choice once again depending on the supply chain as a whole (Figures 4 and 5). A liner is required owing to extremely high pressures or extremely low temperatures. It should be noted that storing hydrogen in a Lined Rock Cavern involves a few technical difficulties that have yet to be resolved.

These four underground hydrogen storage techniques differ in terms of their technology readiness level (TRL) and cost.

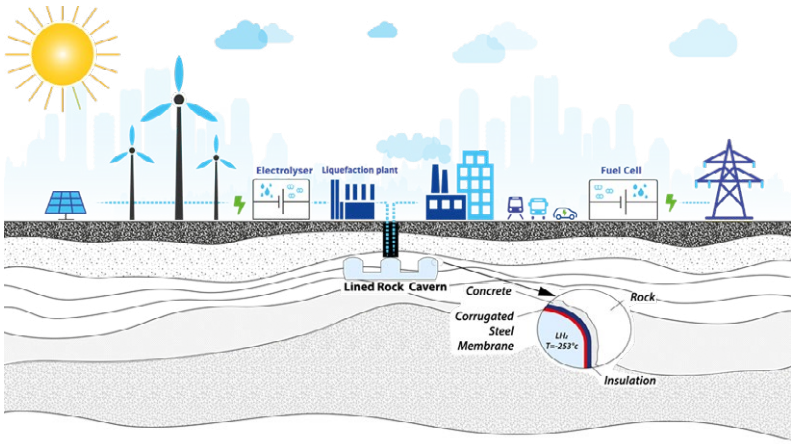


Figure 5: Hydrogen storage in a cryogenic lined rock cavern (LRC)

Salt caverns and porous rock reservoirs are ready for commercialisation, current research being aimed at furthering our knowledge and establishing standards. Demonstrators may be required here and there to address specific local questions and satisfy local decision makers, but no showstoppers have been identified overall.

All four will likely be required in the coming years to satisfy the needs of a booming market and are described more in detail in a complete article presented at the Abu Dhabi International Petroleum Exhibition & Conference in November 2021 (Londe, Louis F. «Four Ways to Store Large Quantities of Hydrogen.» Paper presented at the Abu Dhabi International Petroleum Exhibition & Conference, Abu Dhabi, UAE, November 2021. https://doi.org/10.2118/208178-MS) and available on Geostock website in an unformatted version (https://www.geostockgroup.com/en/four-ways-to-store-large-quantities-of-hydrogen/). ■