Geostock, in collaboration with Saipem-sa and SK Engineering & Construction has developed a technology which allows to store large quantities of LNG at -160°C in Underground Mined Rock Cavern in a safe and economically attractive manner.

MAIN FEATURES

- Combination of two well proven technologies: the storage of hydrocarbons in mined rock caverns and the containment membrane used for conventional LNG tanks and ocean carriers.
- Host rock protected against the extreme low temperature by insulating panels and LNG containment provided by a corrugated stainless steel membrane.
- Hydrostatic pressure and ice formation in the rock mass during the cooling down process controlled by a dedicated water drainage system made of boreholes drilled around the cavern.

WHY?

- With the increase of natural gas consumption, new LNG export and import terminals will be needed.
- Underground storage offers benefits when significant storage capacity are at stake.
- Underground storage minimizes the total space required for LNG terminals and can therefore represent a huge cost saving, especially in industrial areas.
- Environmental, safety and security constraints are likely to rise in the coming decades, thus generating favourable conditions for LNG underground caverns.

KEY BENEFITS

As compared to conventional surface tanks:

- Attractive investment and operating costs
- Improved safety
- Improved security
- Limited environmental impact
- Reduced visual impact
- Better acceptability by the population
- Lower vulnerability to natural events such as earthquakes
A PILOT PLANT BUILT TO VALIDATE THE CONCEPT

From 2003 to 2005, this concept has been validated with the design, construction and operation of a pilot plant in South Korea with the storage of Liquid Nitrogen at -196° C.

Instrumentation has been installed to survey both operation parameters and rock mass thermo-hydro-mechanical behaviour.

The results and data collected during a one-year operation of this pilot plant validated the design. Engineering methods and construction methodologies were refined.

The main findings of the pilot plant:

- No damages of the rock mass.
- Temperature variation and boil-off rate estimates similar to predictions.
- No degradation of the containment system efficiency.
- Drainage system capable to desaturate and resaturate the fissured rock mass.

OPERATION

- The process, equipment, monitoring and control during storage operation are similar to aboveground tanks.
- The piping for LNG loading/unloading and cavern instrumentation passes through a shaft sealed with a concrete plug embedded in the rock mass and supporting the weight of the whole lines.
- The boil-off rate is less than 0.1% per day.