

Decommissioning and Abandonment Procedure of LPG Caverns at Carresse (France)

de Laguérie Patrick⁽¹⁾, Héas Jean-Yves⁽²⁾, Fourmaintraux Dominique⁽³⁾,
You Thierry⁽¹⁾, Brouard Benoît⁽⁴⁾, Bérest Pierre⁽⁵⁾,

(1) Geostock, 7 rue E. et A. Peugeot, 92563 Rueil-Malmaison, France

(2) Total E&P France, BP 22, 64170 Lacq, France

(3) Total E&P, avenue Larribau, 64018 Pau, France

(4) Brouard Consulting, 101 rue du Temple, 75003 Paris, France

(5) LMS, Ecole Polytechnique, Route de Saclay, 91128 Palaiseau, France

Abstract

Total E&P France has decided to decommission its Carresse LPG storage facility located in the southwest of France, 30 kilometers west of the Lacq gas field. They comprise three solution-mined caverns (SPR1, 2 & 4) capable of storing a total volume of 44,000 cubic meters of liquid propane. A fourth cavern of about 10,000 cubic meters (SPR3) was used for brine production and re-saturating.

Since 1962 till 2002, the caverns have been operated continuously as a buffer-storage for the propane produced at the Lacq gas treatment plant. The propane was pumped out for the last time in 2002, leaving the caverns filled up with brine. At that date, Total E&P France launched an extensive decommissioning project with the objective of abandoning the site. This project, which is now completed, comprised three main tasks:

- To recover the propane trapped inside the irregularities of the cavern walls (geometrical traps) by using an innovative and cost-effective methodology.
- To carry out a large program of investigations and experiments in order to determine a safe and environmentally sound procedure for well and cavern abandonment.
- To prepare the administrative files in accordance with the regulations of the French Mining Authorities.

For recovering the propane remaining in the caverns geometric traps, an innovative methodology (so-called "de-trapping" process) has been developed and implemented. Nitrogen is injected under pressure into the well in order to withdraw brine out of the cavern. By this way the brine level is lowered below the roof of the cavern, down to a pre-determined level. The nitrogen is then depressurized until the pressure in the traps decreases below the propane vapor pressure. Therefore, the liquid propane vaporizes and gaseous propane is expelled out of the traps. It is collected on surface and burned. After the recovery is complete, the cavern and the well are again filled up with brine.

Before the operations, numerical simulations have demonstrated the stability of the caverns under the very low internal pressure conditions that will be encountered. A permanent microseismic monitoring system, which had been specially installed on the site, did confirm the cavern stability during the whole duration of the operations. The recovery operations started in June 2003 and should be completed in September 2004. About 1,650 m³ of liquid propane have been recovered from the three caverns.

This innovative methodology has been proved efficient and cost-effective. It differs from others, which require the complete filling of the cavern with nitrogen to replace the trapped product. Such operations imply the use of a huge quantity of nitrogen and are of very high cost.

For predicting the long-term behavior of the caverns after plugging, an extensive program has been carried out. Its objective was to evaluate the combined effects of salt creep, temperature increase and brine permeation. Temperature measurements were done in 2003, which showed that caverns are not far from the thermal equilibrium with the surrounding salt rock, so that the difference of temperature should be less than 1°C at the expected plugging date. A one-year in situ creep test on SPR3 cavern and numerical simulations have shown that for the equilibrium pressure of the caverns will be far below the geostatic pressure. Therefore, it will be no risk of fracturing the rock.

From this program, which was designed for Carresse and was successfully applied, a methodology for the prediction of the post-abandonment behavior of solution-mined caverns has been developed. This methodology can be easily adapted for application to other cavern abandonment cases.

As the result of the program, the plugging of the wells and the dismantling of the Carresse facilities should be carried out as soon as in 2005. At the request of the French Mining Authorities, a period of observation of three years after plugging should have to be respected. Should no significant event occur during this period, the French Ministry of Industry should grant an Abandonment Permit to Total E&P France.

Key words: LPG storage, solution mined caverns, liquid propane, France, abandonment, traps, propane recovery, in situ creep test.

©2022 – Solution Mining Institute
Full Paper is Available in the SMRI
Library(www.solutionmining.org)