# Guy Gistau Looks Back at His Career

by Guy Gistau, Cryoguy, ret. Air Liquide, guy.gistau@orange.fr

I was "born to cryogenics" in April 1965. My first job was building small hydrogen and helium liquefiers at the Air Liquide Centre d'Études Cryogéniques in Sassenage, France.

These machines had been developed at the beginning of the '50s by Louis Weil and Albert Lacaze from the Centre National de la Recherche Scientifique (CNRS) in Grenoble. At this time, no cryogenic expansion turbines were available. We had only the Joule-Thomson expansion as a potential process. As one may know, expansion of helium through a valve cools helium only if the upstream temperature is lower than the inversion temperature, which is around 40K for the usual pressures. That means that the well known and easy liquid nitrogen precooling was not sufficient to get a further cooling by the Joule-Thomson expansion.

We had to get a colder cryofluid for precooling; the only possibility was liquid hydrogen. Therefore, we had first to build a hydrogen liquefier! That was rather easy: liquid nitrogen precooling (the hydrogen inversion temperature is around 200K) followed by a Joule-Thomson expansion from 120 bar (see Figure 1). However, to improve the cycle yield, we were pumping on liquid nitrogen in order to lower the temperature down to about 65K (0.150 bar).

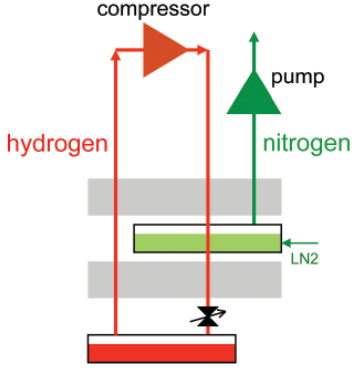


*Figure 1: The hydrogen liquefier*

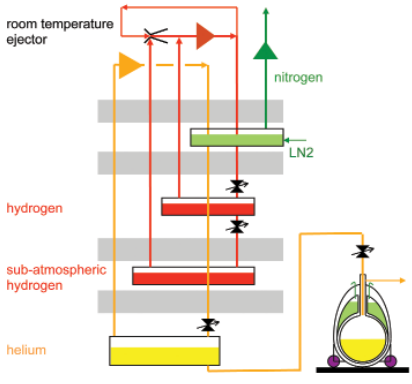


*Figure 2: The 7 L/h helium liquefier*

And we used exactly the same process to liquefy helium: sub-atmospheric liquid nitrogen precooling, liquid hydrogen precooling and Joule-Thomson expansion of helium from 40 bar.

Again, in order to improve the cycle yield, precooling of the helium Joule-Thomson cycle was enhanced by using liquid hydrogen boiling at sub-atmospheric pressure (see Figure 2). Pumping on liquid hydrogen was performed by a room temperature ejector fed by a part of the flow of the hydrogen cycle compressor.

Liquid helium withdrawal was manual! Around every 15 minutes, the operator had to fill "big" mobile dewars of 25 L (of course, at this time, fitted with a liquid nitrogen guard) by batches of 2 liters.

By the way, ours was an almost similar machine to the one designed and built by Mr. Kamerlingh Onnes at the beginning of the 1900s that allowed him to be the first to liquefy helium in 1908. Fortunately, our machine was made out of metal (see Figure 3).

Seventy of such liquefiers have been sold in various parts of the world.

Surprisingly, there were very few incidents related to hydrogen, and none of them were fatal.

## In the Meantime

Obviously, helium refrigeration and liquefaction technology evolved towards larger machines but also automated ones. One of my babies, HELIAL, was the very first helium liquefier that could be started by only hitting a one-off button.

Tore Supra, a European fusion experiment located in Cadarache, France, provided the opportunity to develop and operate centrifugal cryogenic compressors in order to reach superfluid helium at 1.8K.

The large CERN LEP and LHC refrigerators nearing a 20 kW cryogenic power level were another challenge, this time towards effectiveness, leading the way to the even larger ITER refrigerators.

(Continued on page 27)

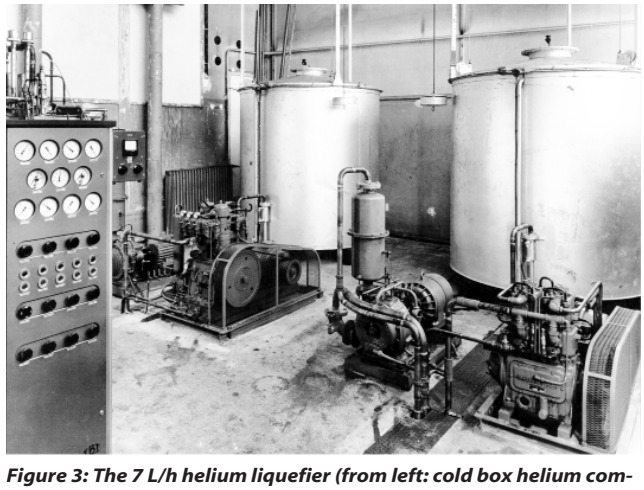

*Figure 3: The 7 L/h helium liquefier (from left: cold box helium compressor, helium gas holder, nitrogen vacuum pump, hydrogen gas holder, hydrogen compressor)*

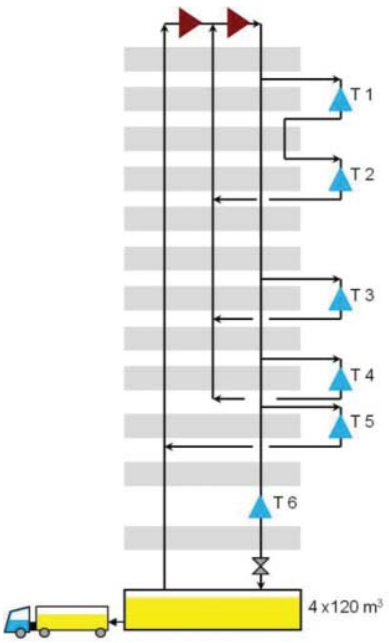


*Figure 4: The 7000 L/h liquefier cycle*

## And Fifty Years Later...

In 2013, the output of the latest largest helium liquefier that is now operating in Qatar is up to 7,000 l/h. It incorporates six cryogenic expansion turbines, each of the two warmest ones extracting 200 kW. See the cycle in Figure 4.

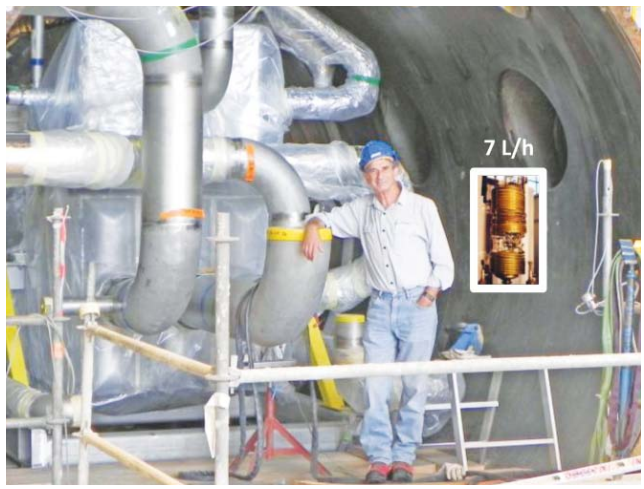


*Figure 5: Inside the cold box of the 8000 l/h helium liquefier (near me, in the white frame, one of my old 7 l/h heat exchanger batteries at the same scale!)*

## I Have Been Lucky!

I consider myself very lucky to have had the opportunity to see an increase of three orders of magnitude in size of equipment I have been building during almost all my professional life.

By the way, I like this job so much that I am still "playing" with cryogenics as a consultant!