ALBA Synchrotron Light Source Liquefaction Helium Plant

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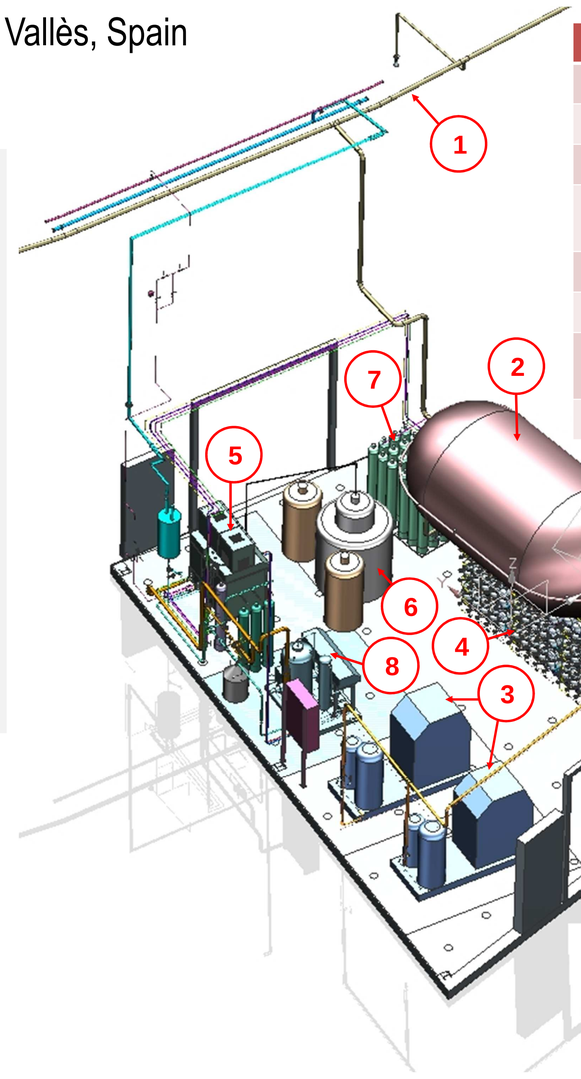
Abstract

ALBA is a 3rd generation Synchrotron Light facility with: 8 operational Beam Lines (BLs), a 2nd BL of Phase II under construction and 3 first Phase III BLs in design phase. Some user experiments require **Liquid Helium (LHe)** as a coolant. The resulting **LHe consumption at ALBA is about 650 l/week**, becoming the main customer in Catalonia.

Thus far the vaporized helium, which results from the refrigeration of experiments and equipment, has been released into the atmosphere without being reused. Due to the increasing price of LHe, **ALBA agreed with ICN2** (Catalan Institute of Nanoscience and Nanotechnology) **to invest in a Liquefaction Helium Plant**. **Internal staff** has **carried out** the **project**, **installation** and **pressure equipment legalization** of the plant, which is located in a new 80 m2 construction adjacent to the main building. Under operation **the plant allows recycling up to** 24960 litres of LHe per year, which is **an 80% of the helium consumed** at ALBA, **by making the gaseous helium undergo through 3** main **stages: recovery**, **purification** and **liquefaction**.

The plant, **unique in Catalonia**, **will entail cost savings about 77% and will reduce vulnerability to supply disruptions**. ICN2 will benefit from a part of the production due to their initial investment.



No.	Description
1	**Recovery Ring**
2	**Gas Bag** (20 m^3)
3	**Recovery Compressor**
4	**200 bar Pure and Impure He Storage** (90 cylinders, 50l/cylinder)
5	Liquefier
6	**Storage Dewar** (1000 l)
7	**16 bar Pure He Storage** (24 cylinders, 50l/cylinder)
8	**Scroll Compressor**

Operation

- Main Stages:

1. Recovery

- Vaporized helium (He) is:
  - Inserted in the 400 m perimeter **recovery ring**
  - Stored in the **20 m^3 gas balloon**
  - Compressed up to 200 bar by the **recovery compressor**
  - Stored in the **200 bar impure helium storage**

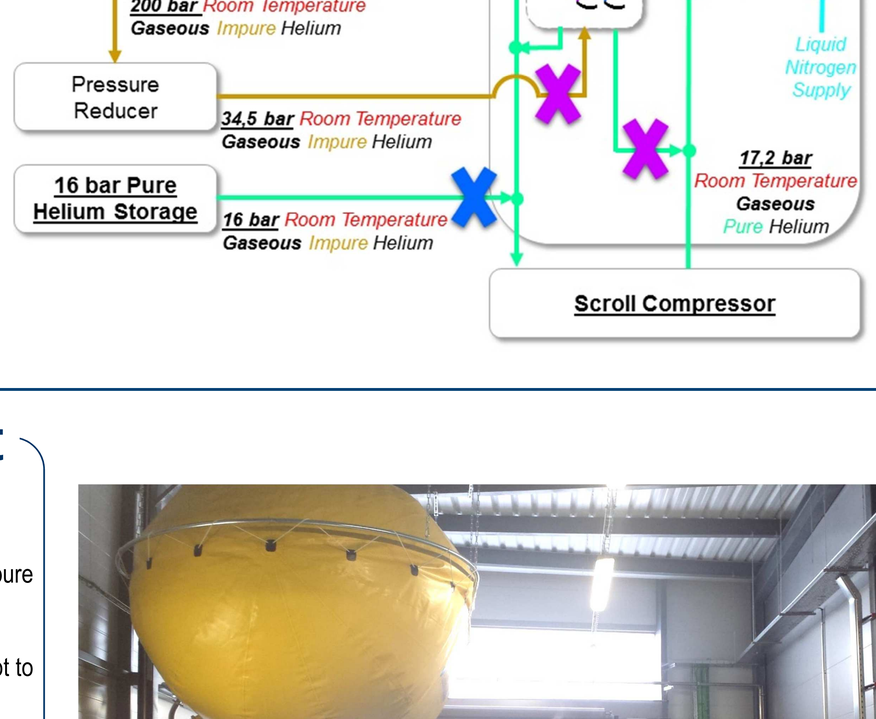
2. Purification

- Liquefier's purifier:
  - Is **capable to clean He gas with up 10% air impurity**.
  - Works ↔ it is cooled below pre-set temperatures.
- Room temperature pure He is:
  - Sucked of the **16 bar pure helium storage**
  - Compressed up to 17.2 bar by the **scroll compressor**
  - Chilled inside the liquefier
- The 17.2 bar cold pure He stream flows through the liquefier's purifier so as to hit its pre-set temperatures. Hereafter the liquefier:
  - Stops sucking the gas of the 16 bar pure helium storage
  - Starts working with the gas of the 200 bar impure helium storage
- The sucked 200 bar impure He is led to the liquefier's internal purifier → its impurities are removed.

3. Liquefaction

- The purified He undergoes:
  - Liquefier's internal expansions → gets colder.
  - Joule-Thomson (J-T) valve → cools below 4.2 K.
- Liquid/gas mixture flows through into the **1000 l storage Dewar**, but the gaseous portion comes back into the liquefier.

- Plant's flow diagram:



Installation Highlights

- **400 m perimeter recovery ring** that has about 100 weld beads.

Production Management

- Plant's liquid helium production: **24 l/h**
- Strategy plan:
  - **For 2 weeks,** store recovered gaseous He in the 200 bar impure helium storage
  - **For 3 days** liquefy helium → **ensures He for 1 week**
- **ALBA will not supply liquid helium to external companies** except to ICN2 owing to its initial investment.

Benefits

- Allows **recycling** an **80% of the helium** consumed at ALBA.
- Leads to **77% cost savings**.
- **Ensures** enough **He for 2 weeks without any new supply.**
  - **Reduces vulnerability** to **supply disruptions.**

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