Air Liquide

Cryogenics in nuclear environment

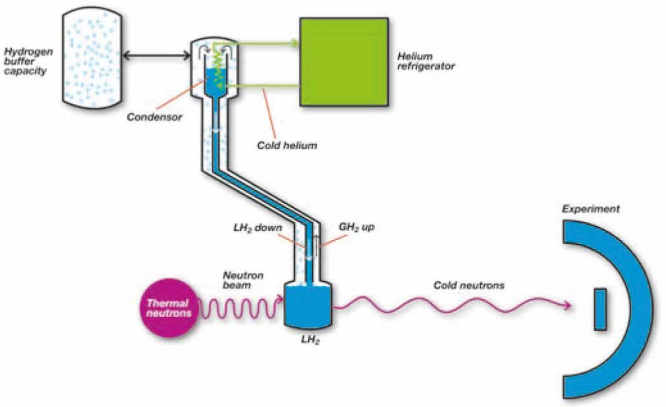
Cold Neutron Sources and Spallation Neutron Sources

Air Liquide, world leader in gases, technologies and services for Industry and Health, supplies customized solutions in mechanical cold production, liquefaction, storage and distribution of cryogenic fluids at very low temperatures.

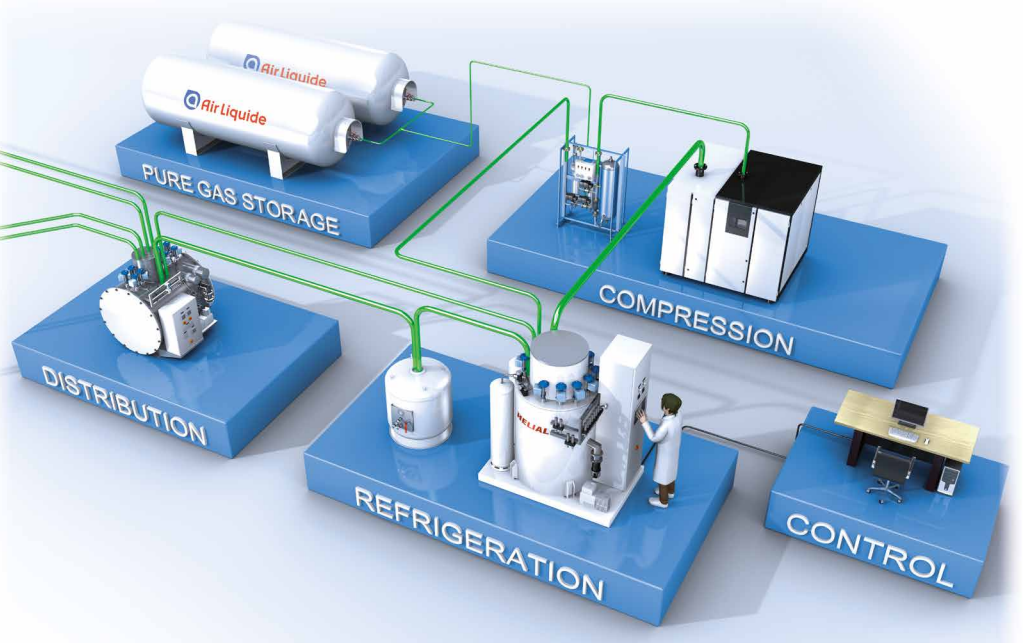
Air Liquide provides tailor sized cryogenic solutions dedicated to Cold Neutron Sources or Spallation Neutron Sources.
Neutron moderation by means of a fluid at cryogenic temperature is the way to get cold neutrons.

The moderation fluid is usually hydrogen or deuterium in liquid phase at a nearly atmospheric pressure or in a pressurized gaseous phase.

Cold Neutron Source principle



A turnkey refrigeration system dedicated to CNS and SNS



Air Liquide designs and manufactures the close-loop refrigeration system necessary to cool down the moderator fluid.

Air Liquide team supports you in all the stages of your project, from drawing up the specifications to implementing the solution. Our cryogenic products are specifically designed according to your needs, from refrigeration to liquefaction.

Air Liquide expertise

- Highly reliable systems
- Supply of components:
  - In-pile components of H2 /D2 loop
  - Helium refrigeration systems
  - Auxiliary circuits
  - High vacuum pumping units
  - Gas purification systems
- Know-how and support of an international group

Air Liquide support

- Preliminary analysis and assistance in the definition of your specifications
- Selection of the most appropriate technologies
- Turnkey solutions
- Operation and maintenance
- Training

Our recent references

ISIS Target Station 2 (U.K.)

- Two helium refrigerators 700 W at 14 K with remote electronics device
- One ATEX liquid hydrogen loop (18 K, 4 bar abs) including two cryogenic circulators (80 g/s each)
- One H_2/He heat aluminium brazed exchanger
- One H_2 converter, pressure mitigation cryogenic buffer
- LH_2 cryogenic transfer line with helium tertiary confinement
- One helium cryogenic transfer line with helium tertiary confinement
- One compressor station (cycle compressor 60 g/s, oil removal & gas management system)

ANSTO (Australia)

- One helium refrigerator 5,000 W at 20 K
- One compressor station (2 lubricated screw compressors 80 g/s each, oil removal & gas management system)
- 100% automatic tunning
- Cold lines 20 K between the cold box and in-pile device (inside the pool)
- 2 modes warm & cold:
  - SO (Stand by Operation) 5 kW at 20 K
  - NO (Normal vacuum jacketed Operation)

CEA Saclay (France)
Orphee Reactor
2 sources

- Helium refrigerator 2 x 750 W at 20 K
- In-pile components including: LH_2 transfer line, helium/hydrogen heat exchanger-condensors (stainless steel, tubular type), water plugs, H_2 buffer capacity
- Gas handling and conditioning circuits
- Replacement of in-pile transfer lines
- Replacement of in-pile water plug
- New helium refrigerator 1,850 W at 20 K

G.K.S.S. Hamburg (Germany)

- One helium refrigerator 1,700 W at 25 K
- One aluminium brazed H_2/He heat exchanger (plate and fin type, TÜV approved)

H.M.I. Ber II reactor (Berlin, Germany)

- One helium refrigerator 2,000 W at 25 K
- One aluminium brazed H_2/He heat exchanger (plate and fin type, TÜV approved)

Von Laue - Langevin Institute (France)
High Flux reactor
2 sources

- One helium refrigerator 13 kW at 25 K
- One in-pile helium/deuterium heat exchangercondensor (stainless steel, turbular type)

Research Neutron Source Heinz Maier-Leibnitz (FRM II) in Garching (Germany)

- Two helium refrigerators
- Two compressor stations (cycle compressor, oil removal & gas management system & buffers)
- One supercritical helium box (including cryogenic circulator) to transfer cold power from refrigerator to customer application (Ultra Cold Neutron Source): 1,100 W @ 4.6 K, 3 bar abs

Institute 401 (China)

- Two Brayton helium refrigerators: 2 x 1,000 W at 20 K
- Two compressor stations (cycle compressor, oil removal & gas management system)
- Manufacture and installation supervision of cryogenic transfer lines to customer application

UCNS Garshing

- Two helium refrigerators: 2 X 500 W @ 4.5 K
- Two compressor stations
- One supercritical helium secondary loop
- Two buffer tanks
- An external purifier
- A liquid helium dewar
- A set of cryogenic transfer lines between these equipment

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