



HTS Cooling

Stirling Cryogenics solutions for HTS applications

Stirling Technology

For over sixty years Stirling Cryogenics has been designing and manufacturing Cryogenerators for extreme low temperature cooling, serving customers all over the world under all possible conditions. This experience is incorporated in our various closed loop cooling concepts, which typically have 3 fields of HTS applications:

- HTS Power Cables. Cooling by sub-cooled one-phase LN₂ flow down to 68K.
- Fault Current Limiters. Cooling by re-liquefaction with boiling LNe or LN₂.
- Generators, Motors and Magnets. (Pre-) Cooling by helium gas flow down to 20K.

The cooling power of these systems is created by the so called reversed Stirling cycle: compression and expansion of helium gas in a closed cycle by mechanical pistons. The medium to be cooled is not used to create this cold: it will just flow through a cold heat exchanger where energy is extracted.

HTS Power Cables

HTS cables need a flow of LN₂ which is sub-cooled to assure a one-phase flow without gas bubbles. The cooling system creates the flow by liquid pumps and the sub-cooling by a pressurized vessel which controls the system pressure. The same vessel also compensates for the contraction and expansion of the LN₂ depending temperature, especially during cool-down and warm-up.



2021 Stirling Cryogenics 67K sub-cooled LN₂ cable cooling system
Courtesy ComEd and AMSC, USA

The cooling power of the Cryogenerators is transferred either by pumping directly through the cold heads, or indirectly using an intermediate vessel with heat exchanger. This is a bath of boiling liquid which is re-liquefied and acts as thermal buffer.

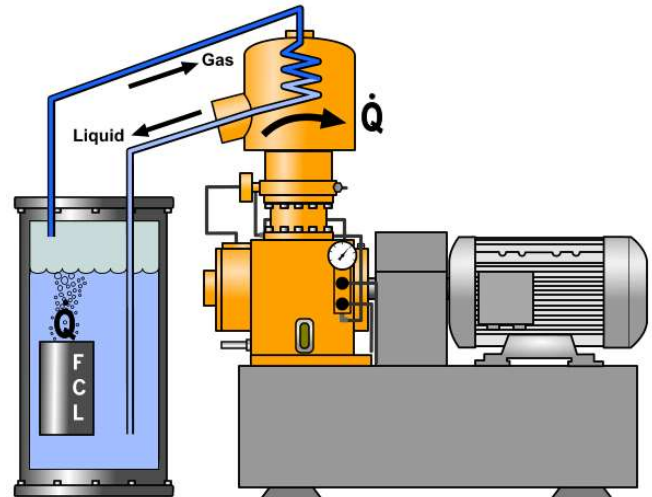
Cooling power available ranges from 500 to over 10 kW at 68K or higher.

Fault Current Limiters

FCL's do not need flow as they are relatively compact and can thus be submerged in a bath of boiling LNe or LN₂.

The gas is directed to the Cryogenerator where it is re-liquefied at the prevailing pressure. This pressure is controlled by the liquefaction capacity, with which the temperature of the bath and FCL can be chosen.

Cooling power available ranges from 500 to 10 kW at 68K or higher.



Generators, Motors and Magnets

HTS rotating equipment needs low temperature down to 20K to function after being cooled down while stationary.

LTS magnets need pre-cooling to minimize LHe consumption to reach 4K. These goals can be achieved applying a flow of helium which is circulated by our CryoFans.

The gas flow will thermally connect the Cryogenerator with the application so its cooling power can be transferred and distributed over different coils and volumes.

Cooling power available ranges from 50 to 1 kW at 20K or higher.

