COLD LN2 fill and drain plans

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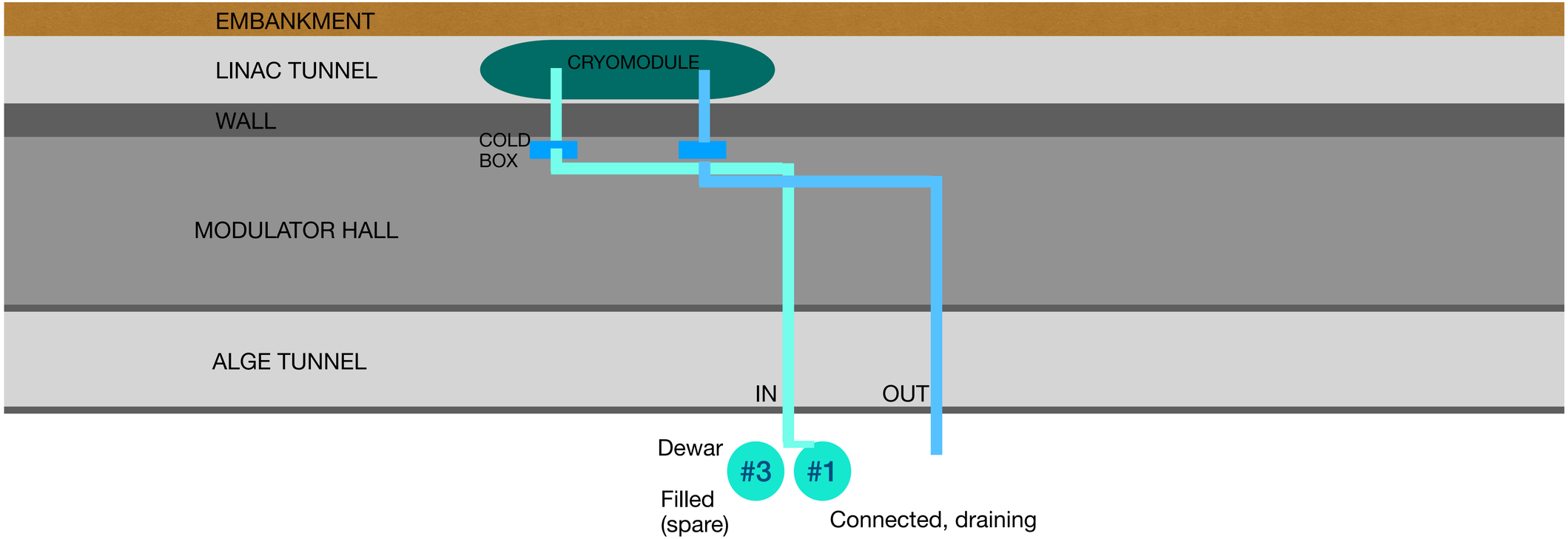
LN2 refill and drain plan

PHASE 0 & 1

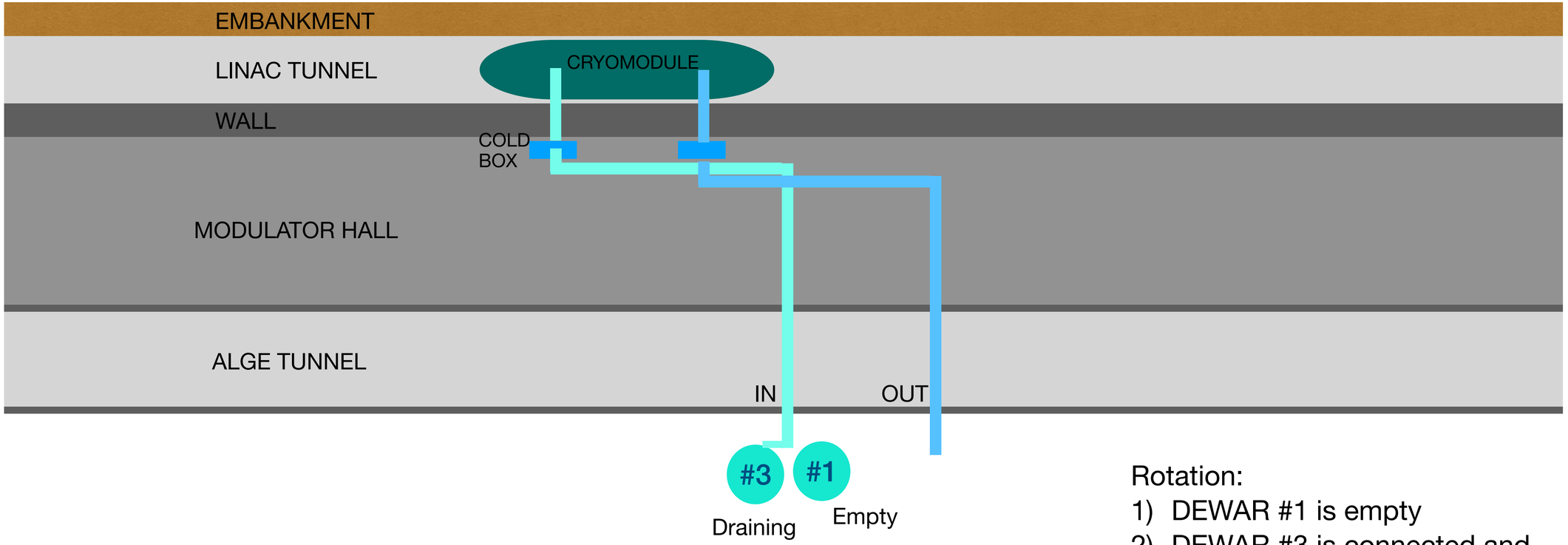


ESRF 01 fountain

#2 Connected, filling

LN2 refill and drain plan

PHASE 0 & 1



Rotation:

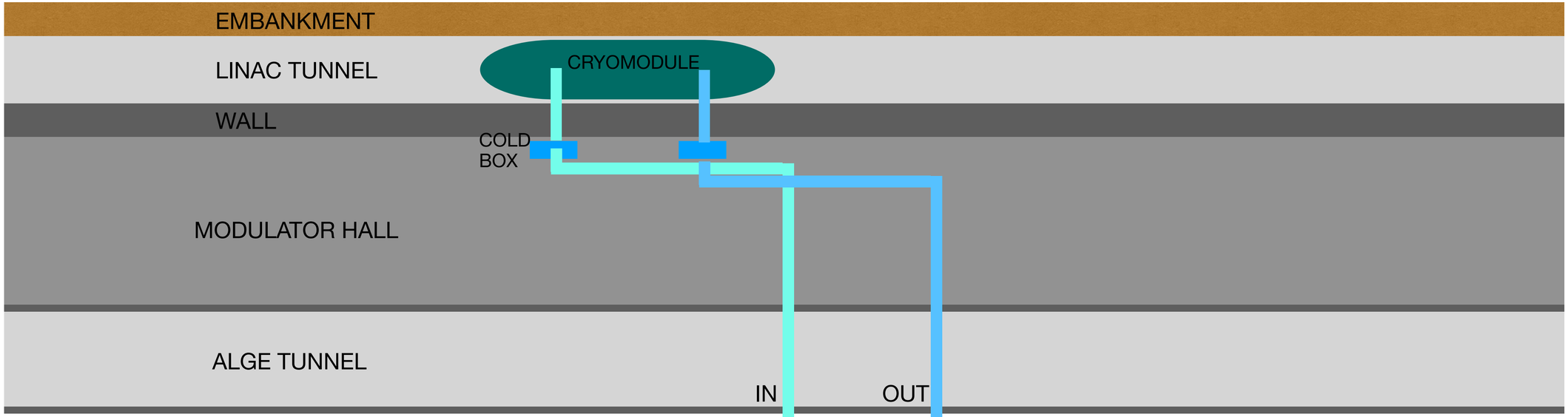
1) DEWAR #1 is empty
2) DEWAR #3 is connected and starts draining

ESRF 01 fountain

#2 Connected, filling

LN2 refill and drain plan

PHASE 0 & 1



#3

Draining

Rotation:
3) DEWAR #1 is transported to LN2 tank

ESRF 01 fountain

#2

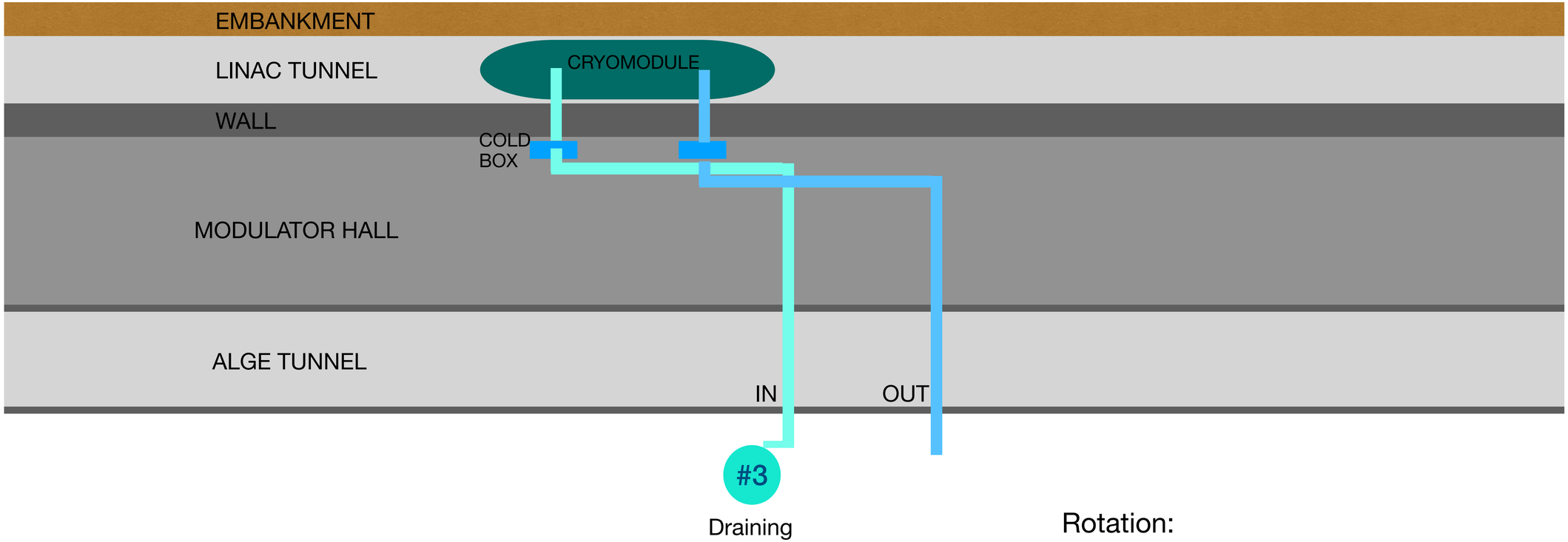
Connected, filling

#1

Empty

LN2 refill and drain plan

PHASE 0 & 1

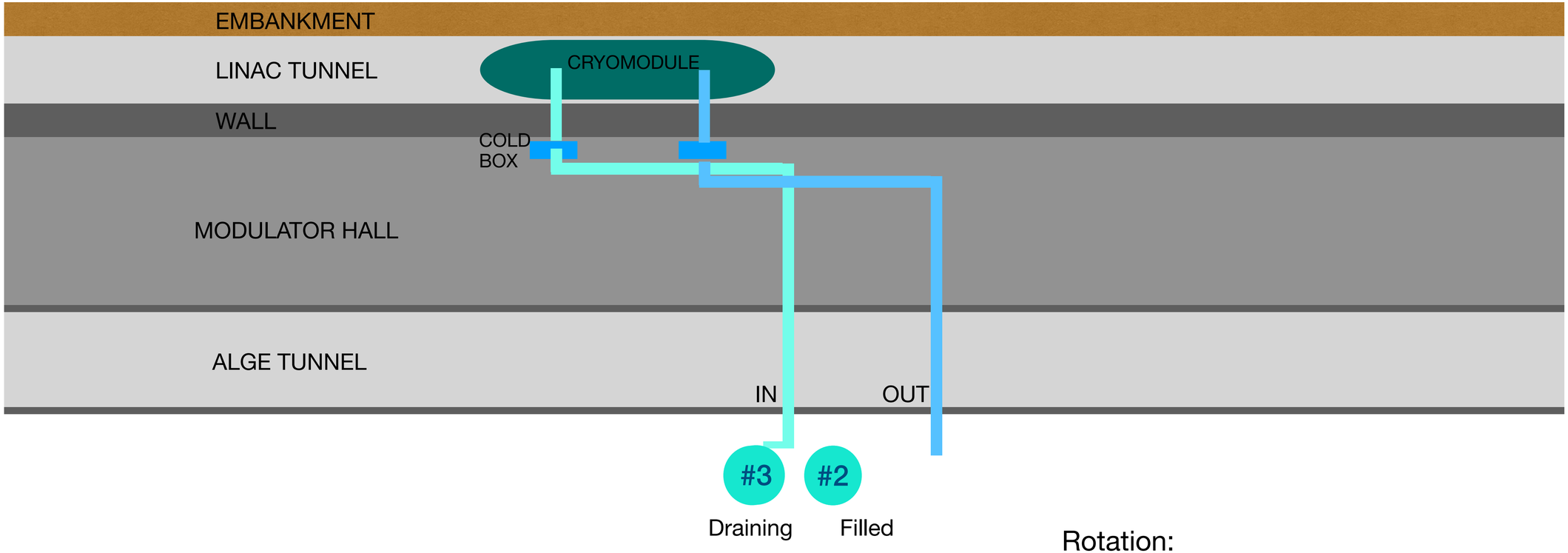


Rotation:
4) DEWAR #2 is disconnected
5) DEWAR #1 is connected to fil at the LN2 Tank

This rotation also works with just 2 dewars, but since we need a spare, we may also use it.

LN2 refill and drain plan

PHASE 0 & 1



Rotation:
6) DEWAR #2 is transported to the COLD site

ESRF 01
fountain

#1 Filling

This rotation also works with just 2 dewars, but since we need a spare, we may also use it.

- Cryomodule maximum consumption 11l/h
- A 300l LN2 dewar will be drained in 27h
- To fill a 300l dewar at the LN2 tank takes: ?hours
- To drain a 300l dewar in the cryomodule takes: ?hours
- How to transport the dewar from LN2 tank to COLD site? A forklift is needed?

The first fill of the cryomodule 1200l will take:

5x time to refill one dewar (4 + transport)

Monday at 9.00: rotation

Tuesday at 9.00: rotation

Wednesday at 9.00: rotation

Thursday at 9.00: rotation

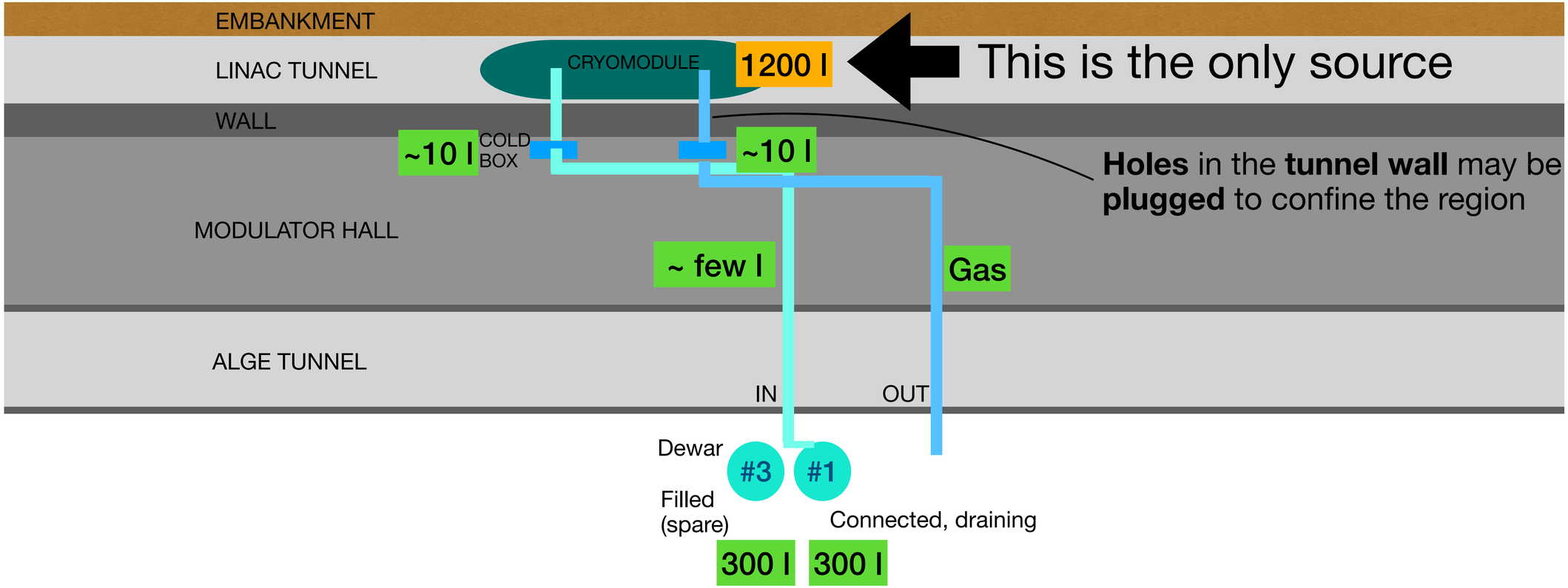
Friday at 9.00: rotation

Saturday: rotation only if in operation and if needed.

Sunday: rotation only if in operation and if needed.

LN2 stored: leak scenario

PHASE 0 & 1



ESRF 01 fountain

#2 Connected, filling

Dewars could be placed in the modulator hall, if i consider this event we shouldn't need an extractor (w/o considering LN2 leaks from the tunnel/cryostat): 2x300l ==> VLN2 (gaz)=410m3; Volume of the modulator hall=2088m3 ==> Concentration of LN2 ~ 20% (the limit should be around 17-18%, we can play a bit with the size or the number of dewars in the modulator hall).

SLAC colleagues Safety QCM assessment

Our safety analysis has all been done with assumption of full release of nitrogen. In our case, similar to your modulator hall, the size of our building is so large that a full nitrogen release does not reduce oxygen levels beyond acceptable limits.

Because of that, we did not have to go further to prove if this situation was feasible. It was easy enough for us to be conservative. If you need to do a more formal risk assessment to justify whether or not a full release is reasonable, we'd be happy to provide input based on our design.

Regards,

Galen Aymar (SLAC)

In a confined space you should also factor in how long it would take for the spilled fluid to vaporize. That will take quite some time. E.Nanni, SLAC

Computations to be done.

Is there any possibility that all the LN2 could flow out of the cryostat ?

The only way that could happen is if something pierces both inner and outer cryomodules in which case a valve would not help.

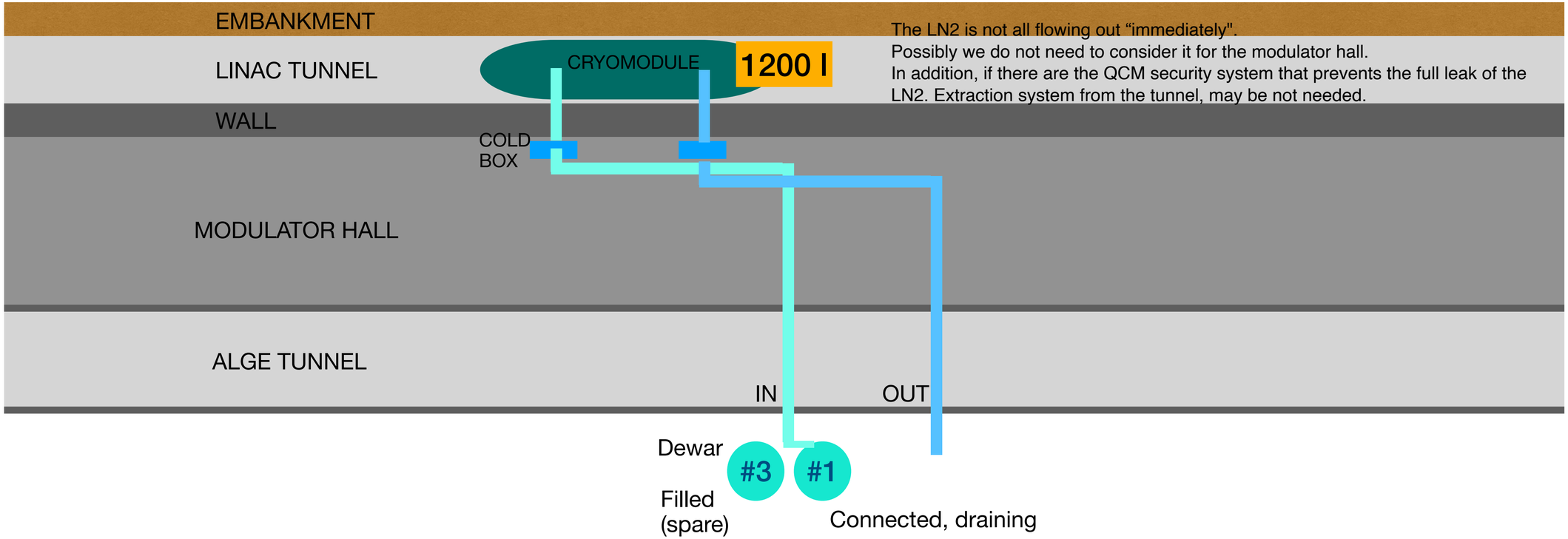
There will be a level sensor that should include an overfill sensor to close the inlet valve if the LN is too high. But even that case would not cause a spill if vent line left the bunker.

The QCM is a sealed pressure vessel. Loss of vacuum and loss of pressure (slightly above ambient, or anomalous excursions) should be interlocked.

E.Nanni, (SLAC)

LN2 stored: leak scenario

PHASE 0 & 1



The LN2 is not all flowing out “immediately".
Possibly we do not need to consider it for the modulator hall.
In addition, if there are the QCM security system that prevents the full leak of the LN2. Extraction system from the tunnel, may be not needed.

ESRF 01 fountain

#2 Connected, filling

Meeting with P.Colomp

LN2 leak in modulator hall. No need for ventilation. Leak from dewar in modulator hall is not an issue.
Including the ventilation system, it is even less an issue.

LN2 leak in cryomodule. No need for ventilation. Leak from dewar in modulator hall is not an issue.

LN2 dewars and cryomodule will be checked yearly or every N years. Air liquide can check the dewars.

Need to know settings of valves

Then will speak with Bertrand Pellissier and cryo-diffusion Company

OK FOR Dewars to be outside.

CHECK tubes. Venting valves. For 30 min mostly gas, due to temperature of tubes

Meeting with P.Colomp

Gas exhaust locations to be considered.
When topping cryocooler, no issue.
Every time you refill cryomodule, will take time to cool down the lines. F.Favier, foresee extraction to outside
May connect all exaust gas lines together

Must know the “Tare” value at which releasing.
Some time produce ICE, not good because blocking.

Yearly check dewars, release valves.
PC will Meet people from CEA to check if computations are realistic

Meeting with P.Colomp

Typical leak to be evaluated

Dewars outside better. OK also in Mod Hall without any additional extraction system.

Cryo-module to be assessed, drawings access OK now.

O2 mask to enter the tunnel. Need trained people.
Oxigen meter and active report of oxygen deficiency.

LN2 leak procedure is not new at ESRF. Already used for EBS RF cavity overpressure.

Training with Pelissier + cryo-diffusion

Meeting with P.Colomp

Control room operators could be trained to manipulate cryocooler and dewars. Operation manager may be not ok with this. Few operators in normal days.

1-2 people identified from COLD project to coordinate cryogenics

Bertrand + Gregory

Plan training (practical and safety): list of people to be trained.
All COLD people to be trained on LN2 safety hazards

Options available

LN2 installation	Phase 1	LN2 installation	Phase 2	COST
Dewars in the modulator hall.	45keuros for 3 dewars + ~6m LN2 pipes (15 keuros)	LN2 tank outside modulator hall. + additional LN2 network	+185keuros	~245 K euros
Dewars outside the modulator hall.	45keuros for 3 dewars+ ~35m LN2 pipes (100 keuros)	LN2 tank outside modulator hall.	+100keuros	~245 K euros
LN2 tank outside modulator hall.	LN2 tank outside modulator hall.	Nothing	+0 keuro	~200 K euros + LN2 tank rent

15 keuro for 1x 350l dewar rated to operate outside and transportable

ADVANTAGES:

No LN2 in modulator hall, easiest safety wise

No impact to ESRF linac operation

Easier maintenance

More space for hardware in mod.hall

Avoid difficult access to ESRF-01 LN2 fountain

Disadvantage: more investment for Phase 0 and 1.

An LN2 tank will be installed

LN2 refill and drain plan

PHASE 2