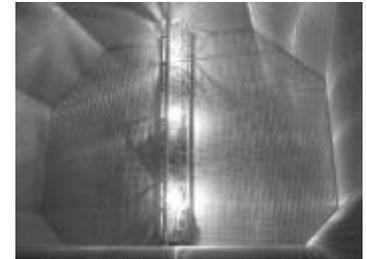




*Expert in LNG*

# Membrane cryostats for large volume neutrino detectors

**European cryogenic days**



June 9<sup>th</sup>, GENEVA

Safety

Excellence

Innovation

Teamwork

Transparency

# Disclaimer

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# Agenda

- ▶1- Company overview
- ▶2- A first prototype: 17 m<sup>3</sup> LAr tank
- ▶3- Two new 600 m<sup>3</sup> LAr tanks
- ▶4- Next step



# Company overview

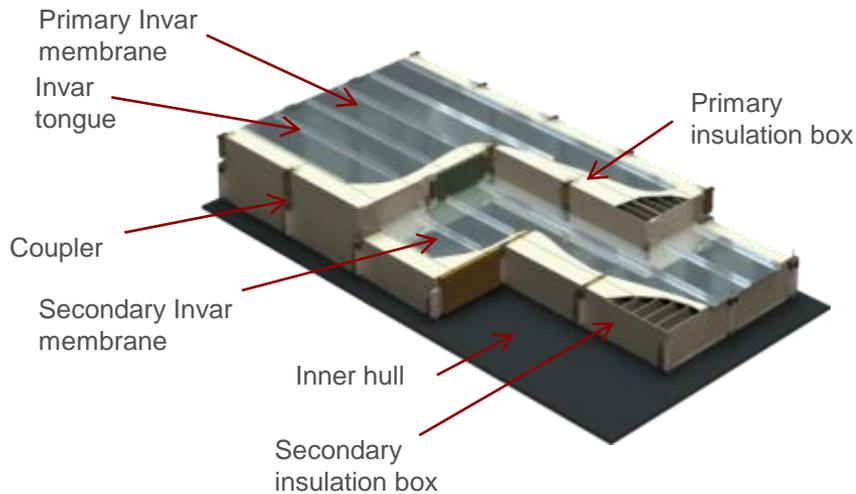
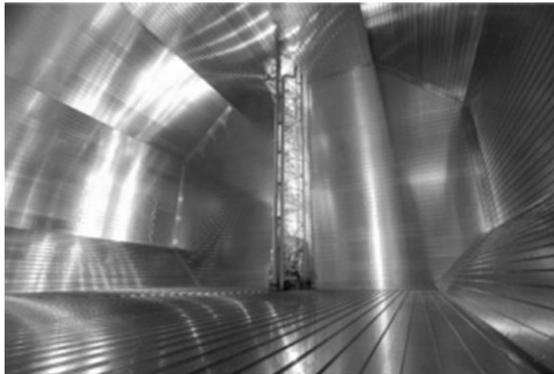
# GTT in brief

- ▶ An engineering company with more than 50 years of experience in the design of the Membrane Cargo Containment Systems for cryogenic liquids
- ▶ GTT is a public company listed on the Euronext Stock Exchange (Paris)
- ▶ About 120 ships and onshore tanks currently on order
- ▶ Around 380 highly qualified people, mainly at head office, but also present worldwide
- ▶ One project already designed for CERN and two others ongoing

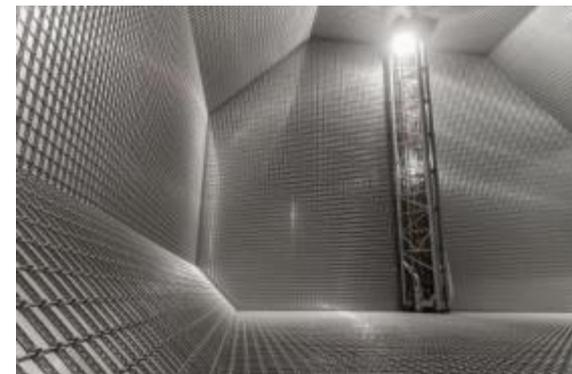
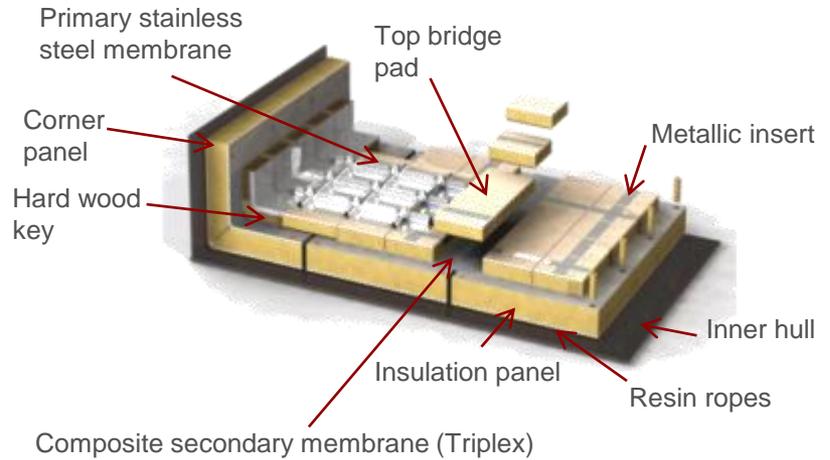


# GTT membrane technologies

## NO96 system



## Mark III system

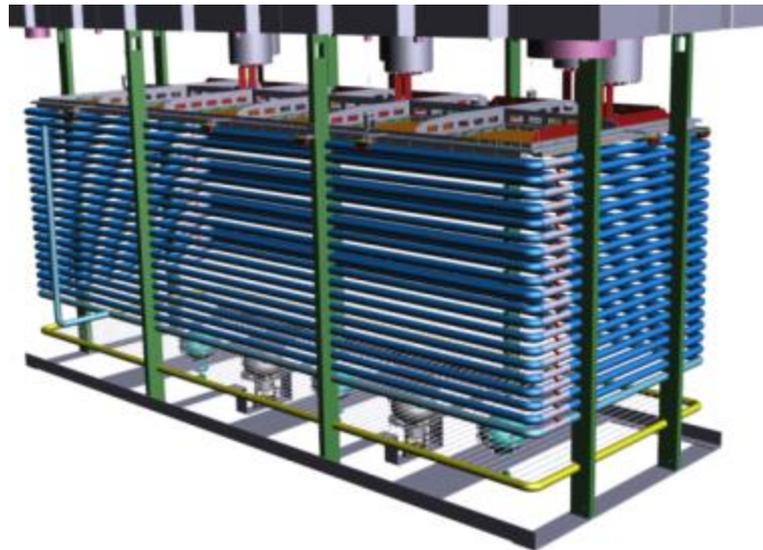




## A first prototype: 17m<sup>3</sup> Lar tank

# Context

- ▶ **Main targets of the « prototype », a 17m<sup>3</sup> tank containing liquid Argon**
  - ▶ Approving membrane technology in contact with Argon (keep the Argon very pure)
  - ▶ Approving the thermal efficiency of the insulation system
  - ▶ Approving the instrumentation system developed to detect neutrinos



# A real challenge for GTT

## ▶ First time for GTT to design container for Liquid Argon:

### ▶ Argon specificities

- ▶ -188° C
- ▶ 1400 kg/m<sup>3</sup>

▶ Keep an high purity of the stored Argon (no pollution from containment system)

▶ Tightness of the primary container reaching 10<sup>-9</sup> mbar.l.s-1

## ▶ Tank: Three liners of insulation (1m)

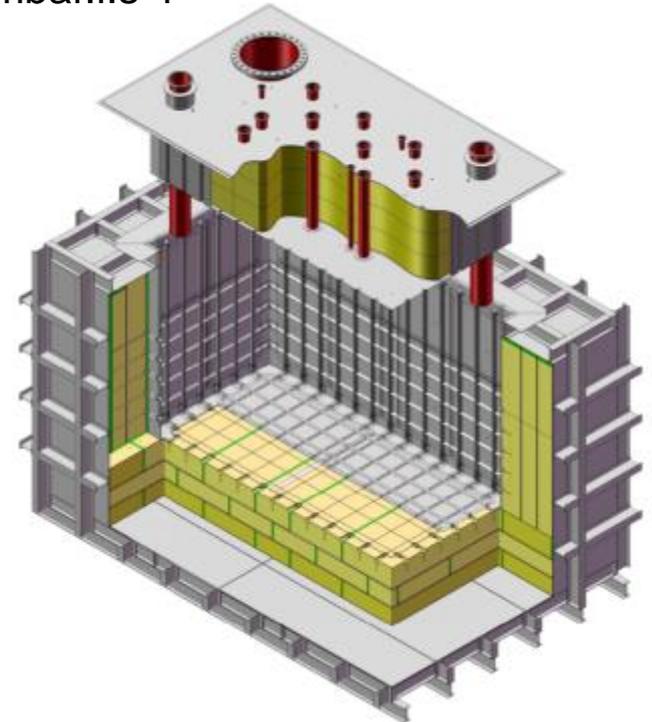
▶ Thermal flux limited to 5W/m<sup>2</sup>

▶ Foam density: 70kg/m<sup>3</sup>

## ▶ Top cap

▶ about 20 crossing pipes in 6m<sup>2</sup>

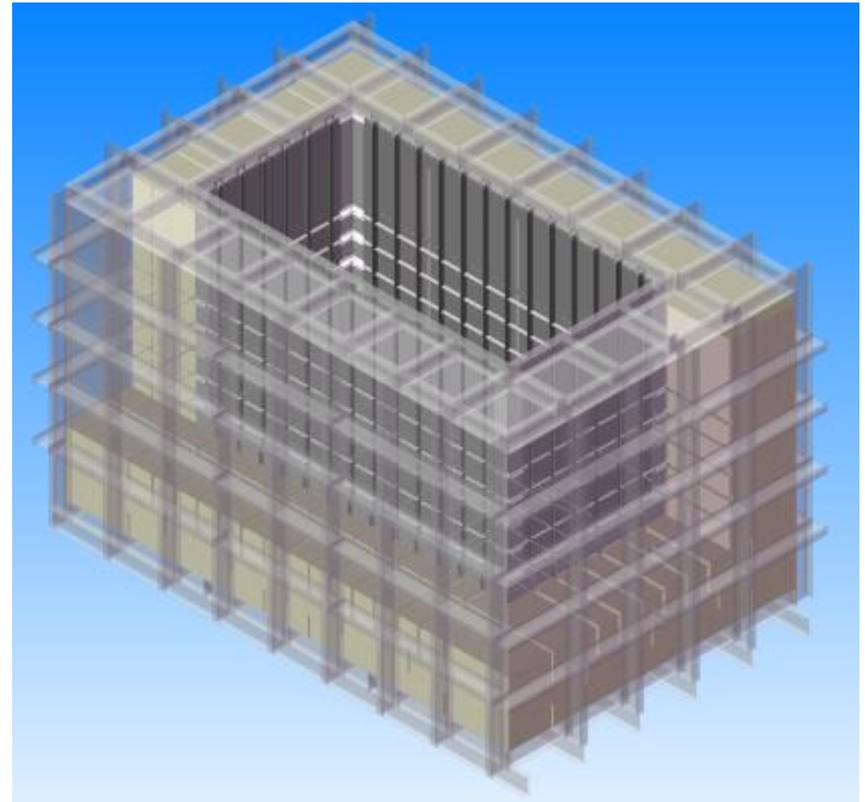
▶ Removable element



# An innovative solution

## ▶ Adapted to CERN needs:

- ▶ 3 isolating layers: 400mm + 2\*300mm
- ▶ Specific panels arrangement
- ▶ Double containment
- ▶ A mix between two insulation systems made of:
  - ▶ Stainless steel (tank)
  - ▶ Invar (Top Cap)
- ▶ Dedicated corrugation arrangement (1.2m high) in upper part of the tank



# Construction already completed

## ▶ Containment system for tank:

- ▶ Built at CERN premises
- ▶ By  GABADI, a company specialized in the GTT's membrane system installation

## ▶ Containment system for top cap:

- ▶ Built at  GABADI premises
- ▶ Already delivered at CERN

## ▶ Next steps:

- ▶ Instrumentation installation is ongoing
- ▶ Top cap installation scheduled during summer
- ▶ Cool down of the tank in the second half 2016

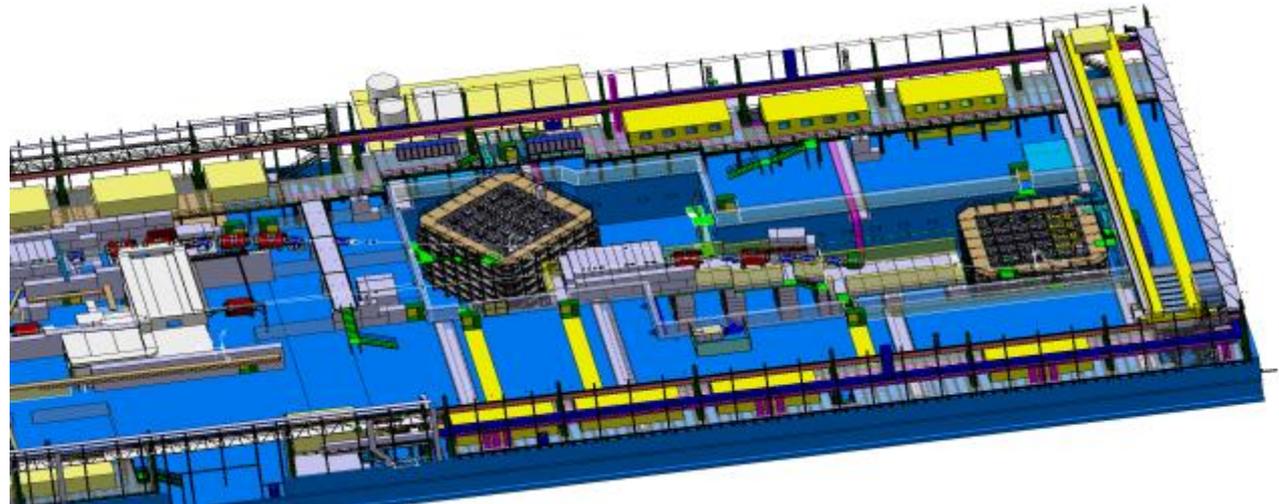




## Two new 600 m<sup>3</sup> LAr tanks

# CONTEXT: Two different detectors

- ▶ GTT's system has been selected for this new step of development
- ▶ NP02 tank :
  - ▶ Double phase TPC (Time Projection Chamber ) as a prototype for the DUNE experiment
- ▶ NP04 tank :
  - ▶ Single phase TPC as a prototype for the DUNE



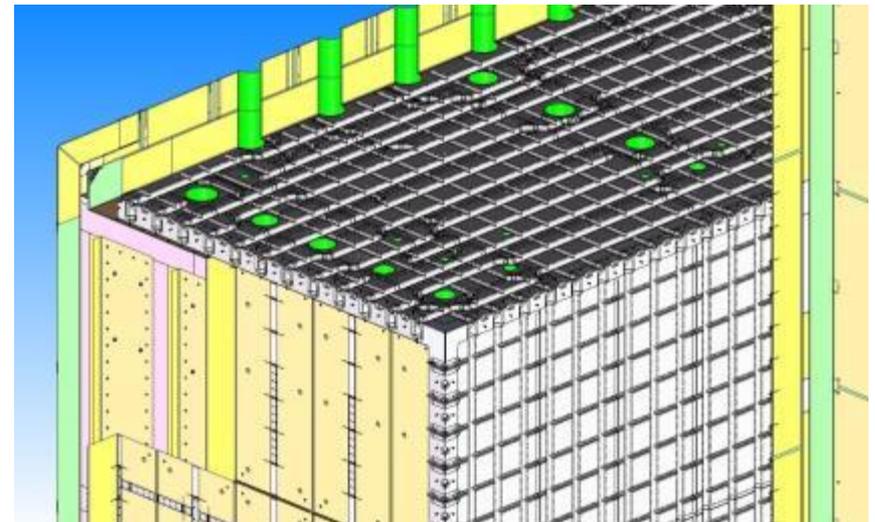
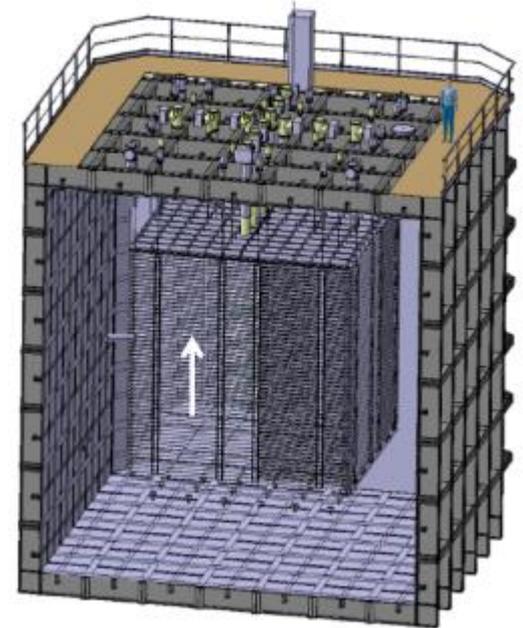
# A new challenge for GTT

## ▶ Two liners of insulation (0,8m)

- ▶ Triple containment system
- ▶ Foam density: 90kg/m<sup>3</sup>

## ▶ First time for GTT to design:

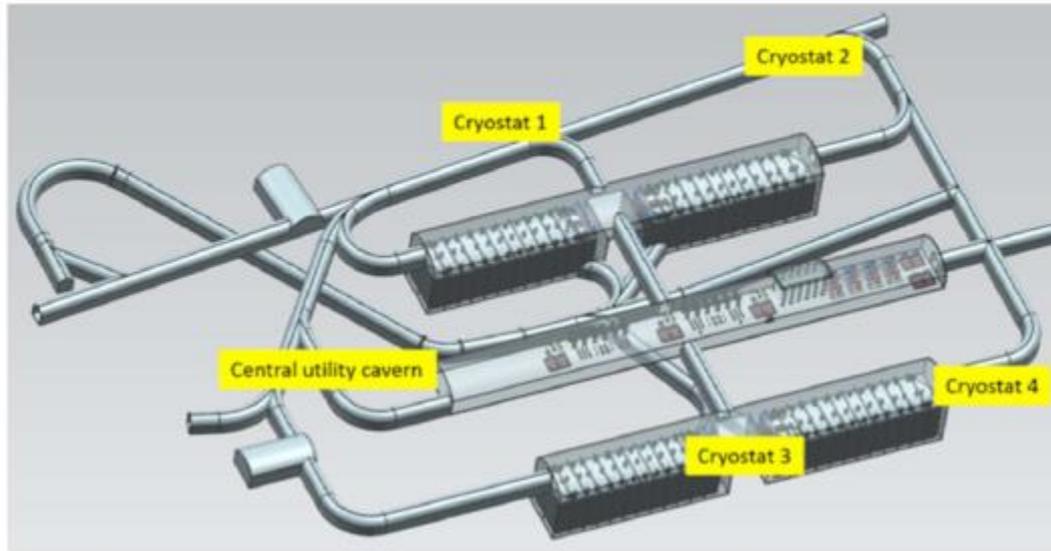
- ▶ Pipes crossing 3 liners
- ▶ High density of crossing pipes (mainly on top side)
  - ▶ About 60 elements from Ø30 to 700mm





## Next step

# Final goal?



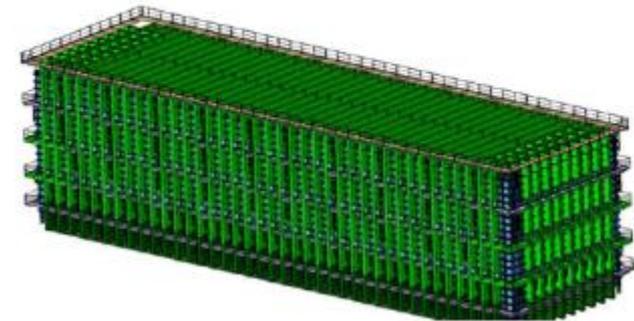
4 detectors in 4 caverns

1'500 m underground

~ 17'400 tons of LAr / detector

Inner dimension (liquid+gas):

- L = 62.00 m
- W = 15.10 m
- H = 14.00 m



**LBNF/DUNE project**

# Thank you for your attention

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