- Allows an **access** to **Top Front-End electronics** at any time

- Insures the **transition** between **cold** and **warm** parts

- Houses a thermal exchanger to **limit** the **heat injection** in the cryostat and to insure an **optimal running** of FE boards

- Is an isolated and independent volume filled with nitrogen at atmospheric pressure

- Houses **50 FE boards** (3200 channels) (10 boards for DP)

- **105 chimneys** to be produced (240 for DP)

Electronics Readout Scheme for Upper Drift Volume

To synchronization DAQ grand master

Up to 10 AMC digitization cards 64 ch each per crate

White Rabbit switch network for clock syncronization

CRO uTCA crate
WR MCH
CRO AMC
MCH

1 Gbit/s SyncE optical link

40 Gbit/s data optical link to DAQ

x4 crates per SFT 2-view
x5 crates per SFT 3-view

SFT Chimney reads up to 3200 CRP ch

Blade for FE card extraction

Cryostat Insulation

Up to 50 FE 64 ch cards per SFT chimney

FE Card

Cold SFT flange

Upper CRP

1/4 CRP element

1/4 CRP element

1/4 CRP element

1/4 CRP element

1/4 CRP element:
2432 / 4 ch for 2-view
3200 / 4 ch for 3-view

Upper CRP

Upper CRP

Conceptual Design Review
Fabien Cavalier, June 4th 2021

Initial Design by CERN for DP

Successfully used for DP prototype

Emergency removable flange with increased N_2 gas flushing

Warm Signal FT (1480 contacts)

Overpressure check valve
Preliminary vacuum valve
Pressure transducer

N. 10 40-twisted pairs Cables and Connectors

Input pipe for N_2 gas flushing

In-Out pipes for LAr bottom heat exchanger

N. 10 34-twisted pairs Cables and Connectors

Pt-1000 connector

Cold FE Analog Acquisition card (32 ch. each)

Cold Signal FT (1360 contacts)

N. 10 Extractable blades with handles for TP cables and FE electronics cards

Guides for blades

2

- For DP, need for 240 chimneys
  => **reduction of cost production mandatory**

- Work lead by Rodolphe Marie at IJCLab in connection with Dario Autiero and Franco Sergiampietri

$\Rightarrow$ Move to CF flanges to LF ones
$\Rightarrow$ Modification of guiding system => **reduction of the numbers of components** and **weldings**
$\Rightarrow$ Design with **simplified machining**

$\Rightarrow$ Cost of **prototype ~12 k€**: probably ½ of this amount for a mass production

2,35 meter
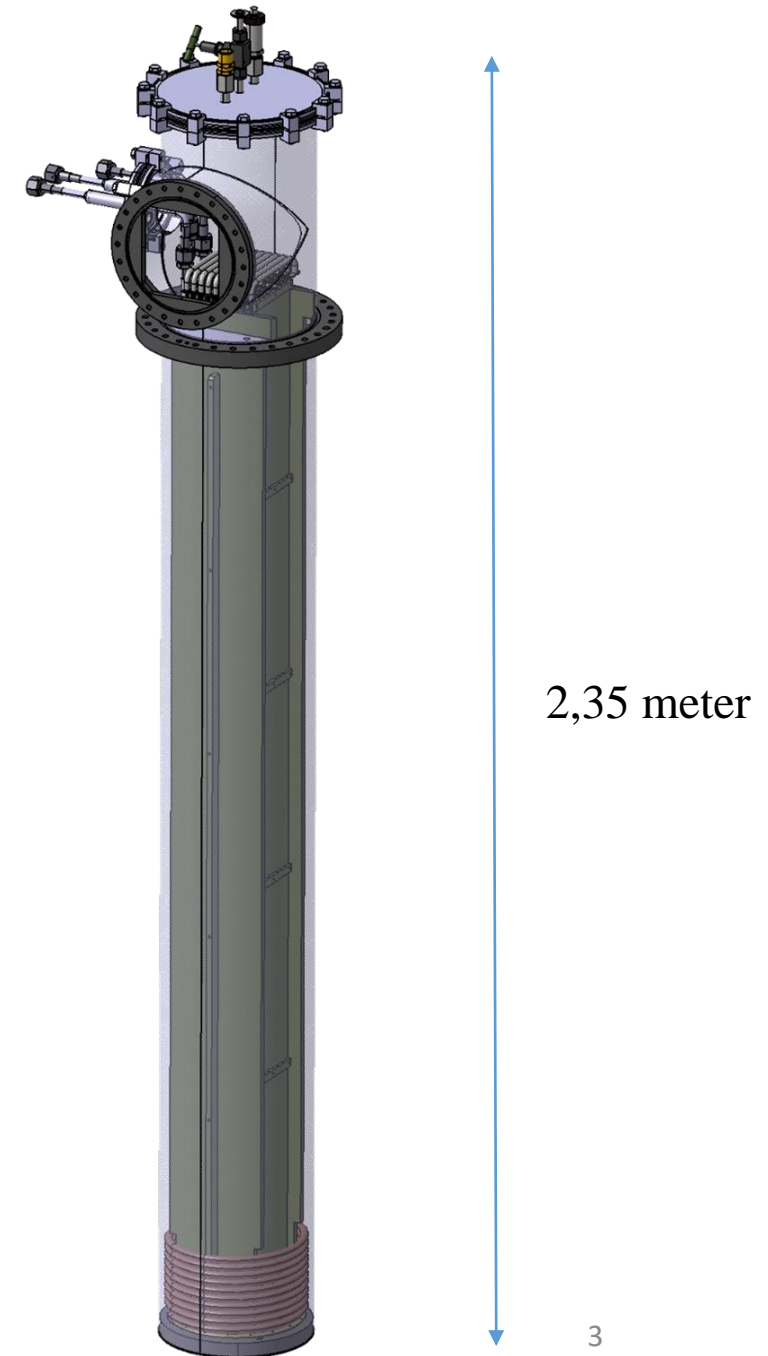
DP Prototype

- Partially produced in the industry

- Finalized at IJCLab workshop

- First Tests driven by A.Gallas in **April 2021** in a **cryostat** with Liquid Nitrogen using **Accelerator Pole facilities and support**
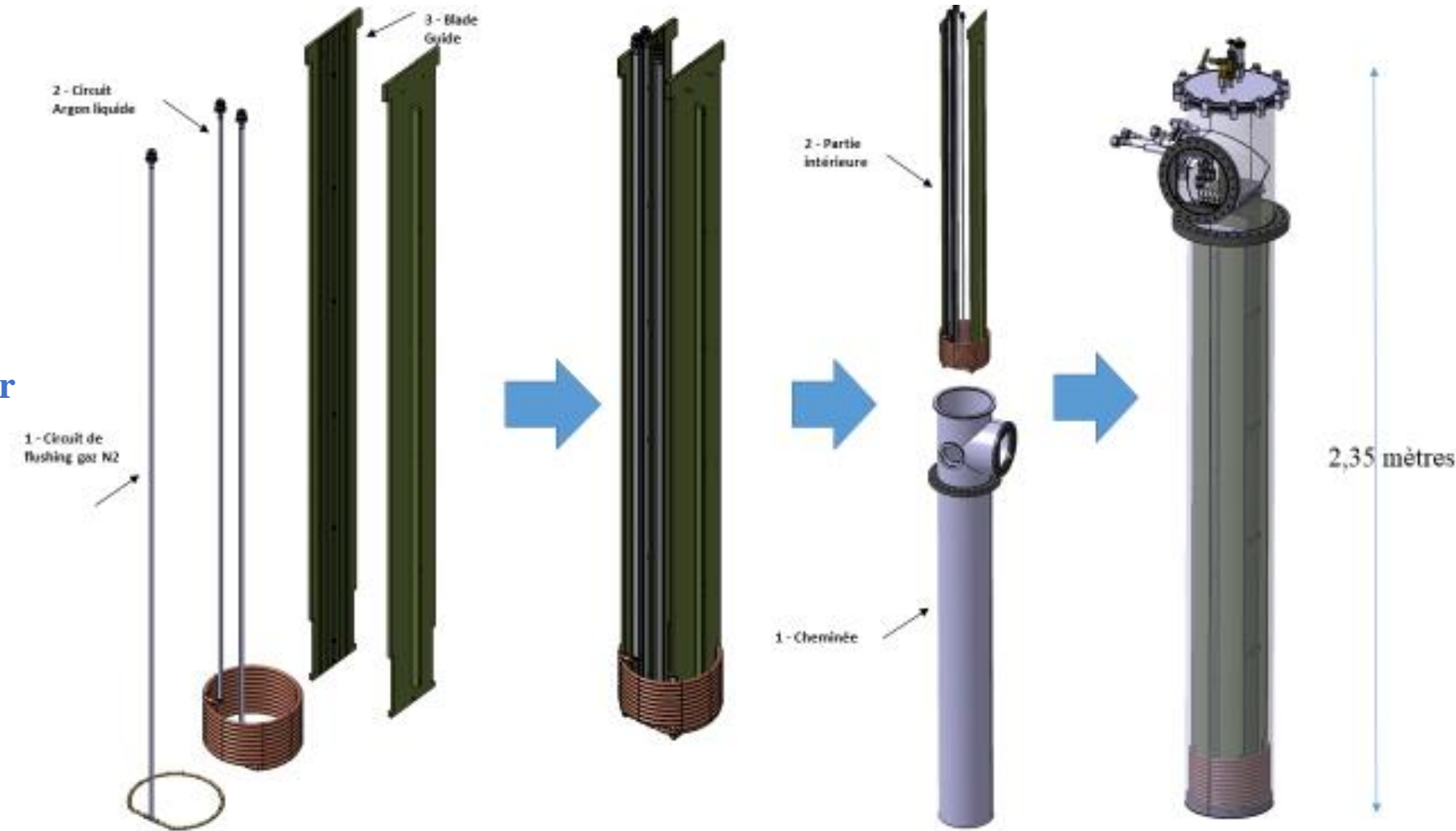
Chimney at IJCLab workshop

Cold Flange Side
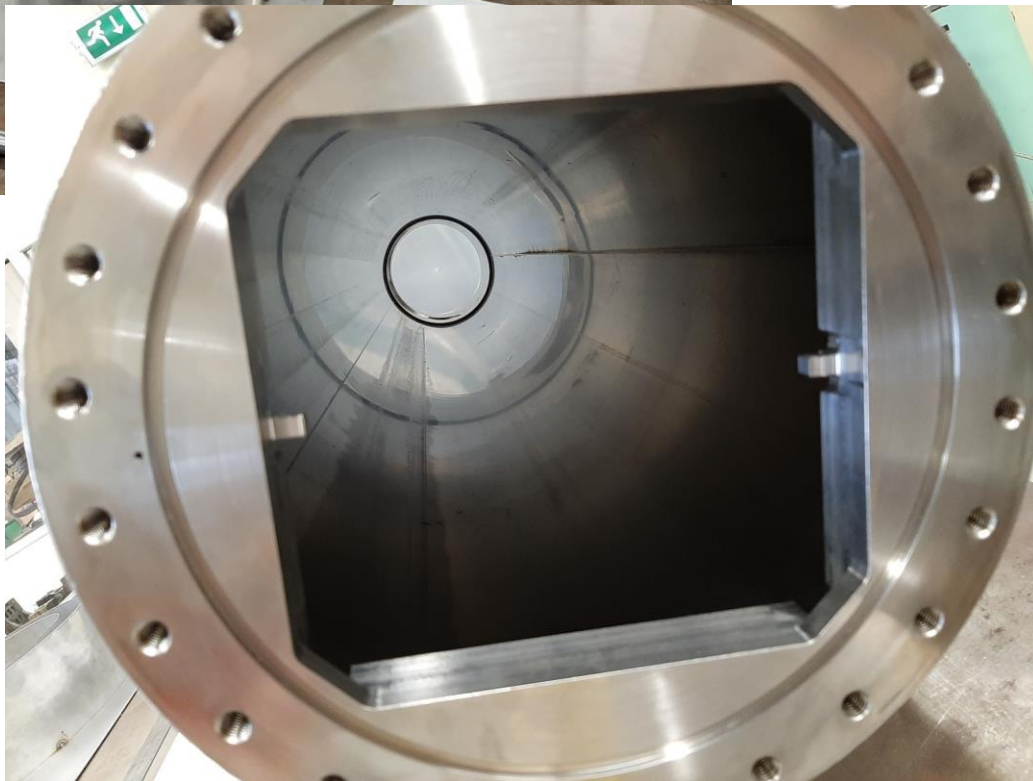
Warm Flange Side

Chimney Prototype

N₂ gaz Out

Liq N₂

Cryostat
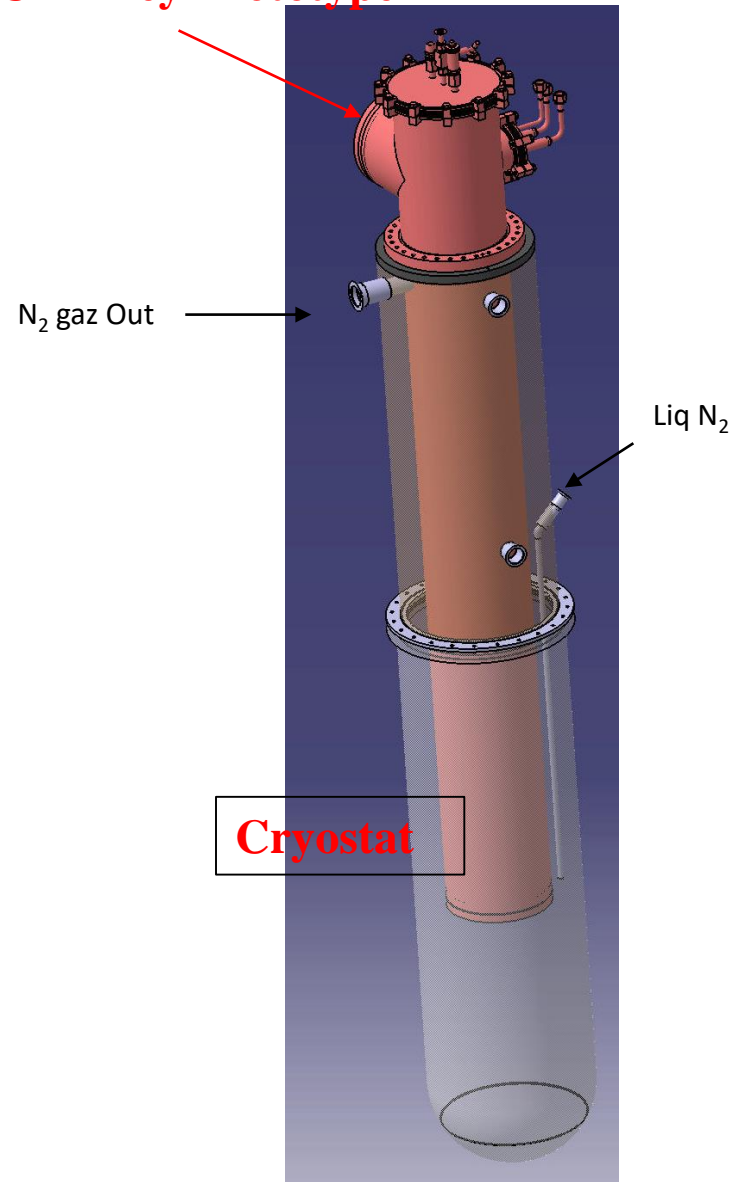
Tests Status

- **Sealing not correct:** one welding (done in the industry) at the top which cannot be easily fixed

$\Rightarrow$ remaining leak ($\sim 10^{-4}$ mbar l^{-1} s^{-1})

$\Rightarrow$ few 10^{-2} mbar obtained

(reminder at CERN (10^{-3} mbar))

- **Not critical for cold tests**

- **Welding not present for ColdBox chimneys** (no cooling circuit)

- To be taken into account for VD design
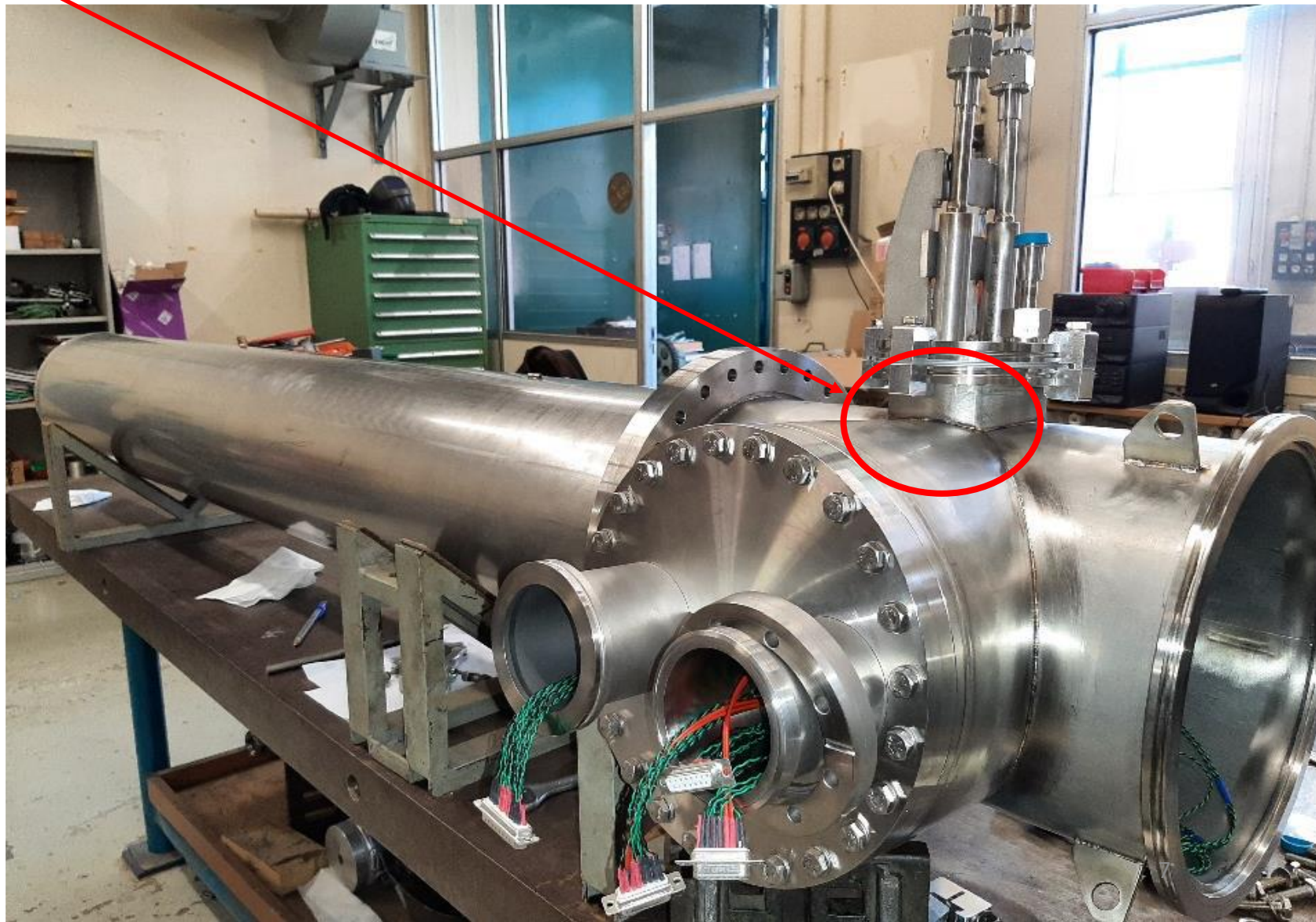
- Test in a cryostat filled with liquid Nitrogen

- Introduction of **blades**:
  - at **warm** temperature **OK**
  - at **cold** temperature **OK**

- **Electrical continuity** tests at cold for bottom part: **OK**

- Temperature profiles (tube, blades) with/without a simulated FE board heat dissipation
  - 6 measurement positions for 2 blades and on the tube
 - 1 measurement every minute
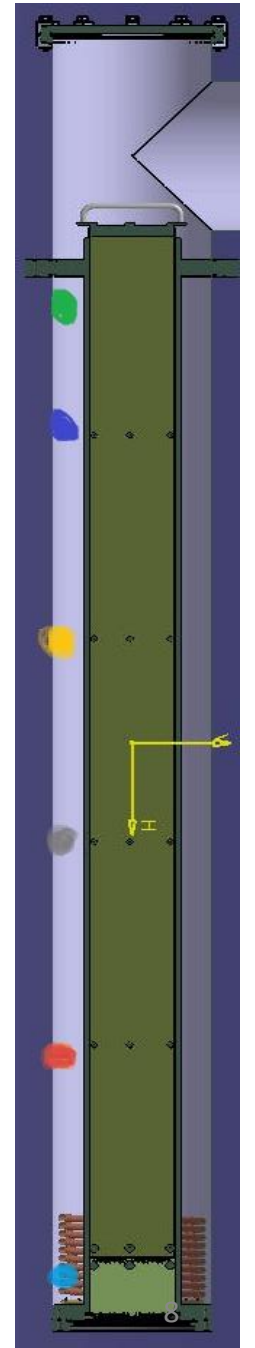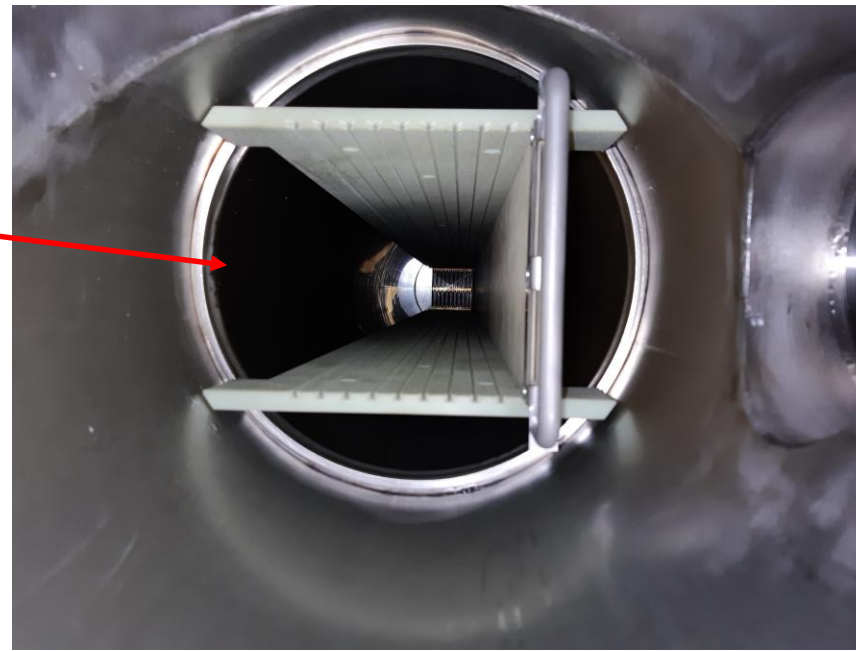
- 9h35 : Nitrogen flushing
- 10h : blade removal and tests of all slots
- 10h05 : cooling : Nitrogen injection in thermalisation circuit
- 10h20-11h10 : heating with 2x5W (change of slope in cooling)
- 12h00-14h: tries to adjust temperature in the bottom part

Temperature on Central Blade
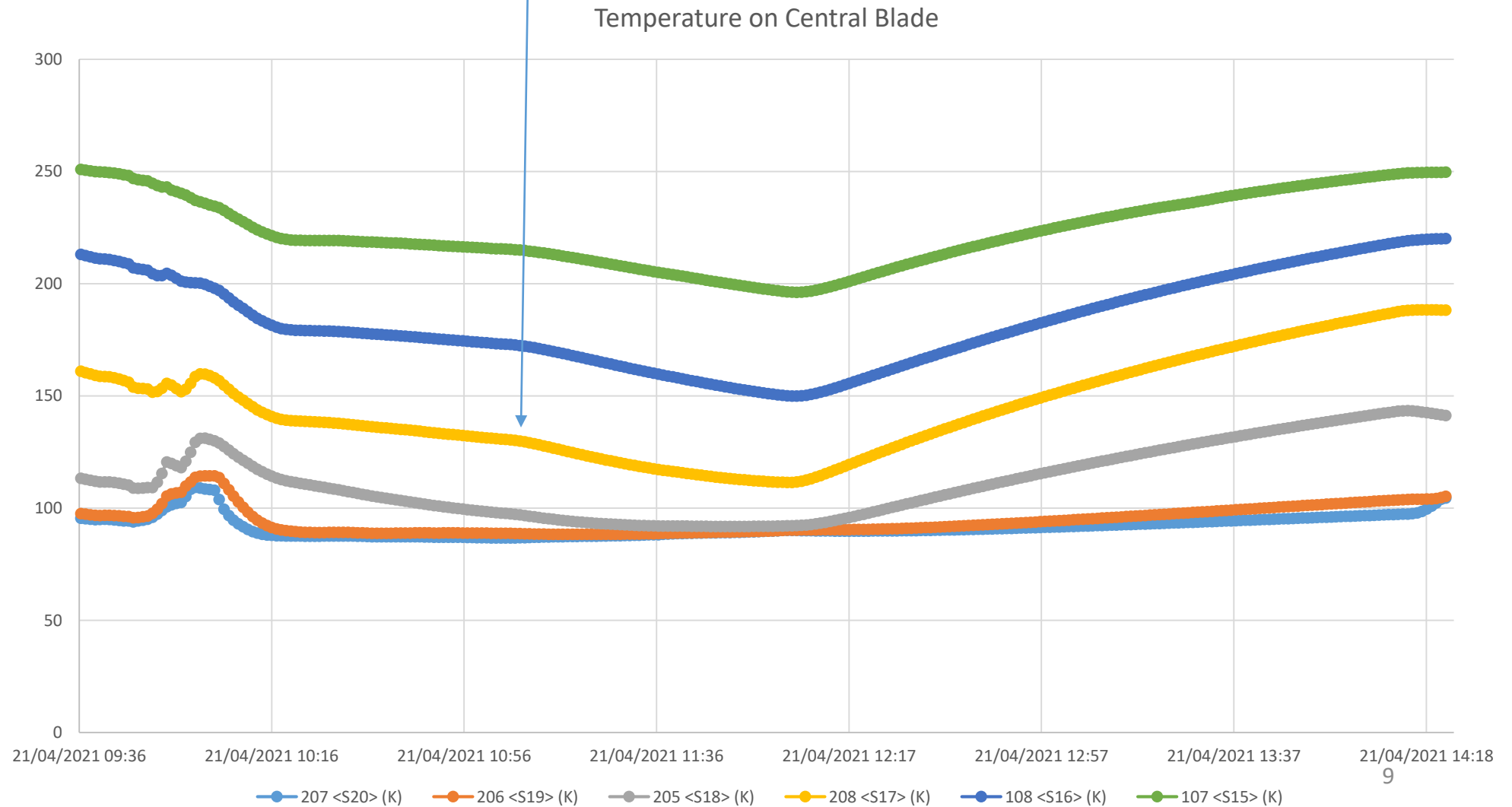
- Effect of blade removal and introduction
- No increase due to heating start: just a change of slope in cooling (see previous slide)

Temperature on Central Blade
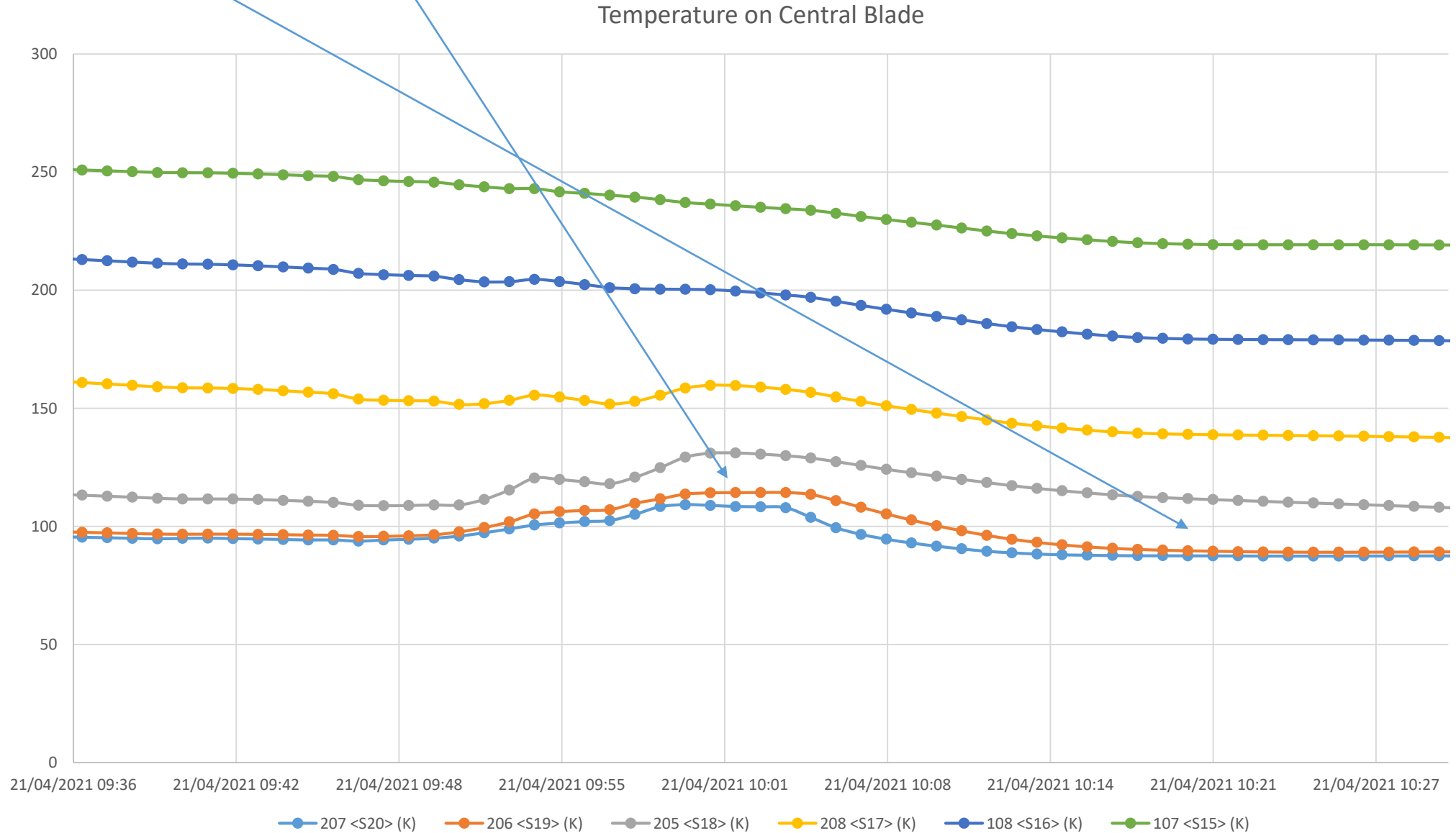
Coldbox chimney

- Design similar to DP prototype, **just length adaptation**

- Suppression of heat exchanger

- **5 chimneys** under production in the industry
  - Welding for the 5 chimneys ended today
  - Cleaning and leak tests next week
  - Delivery expected in 10 days

- Cost: **9 k€ per chimney**

810 mm
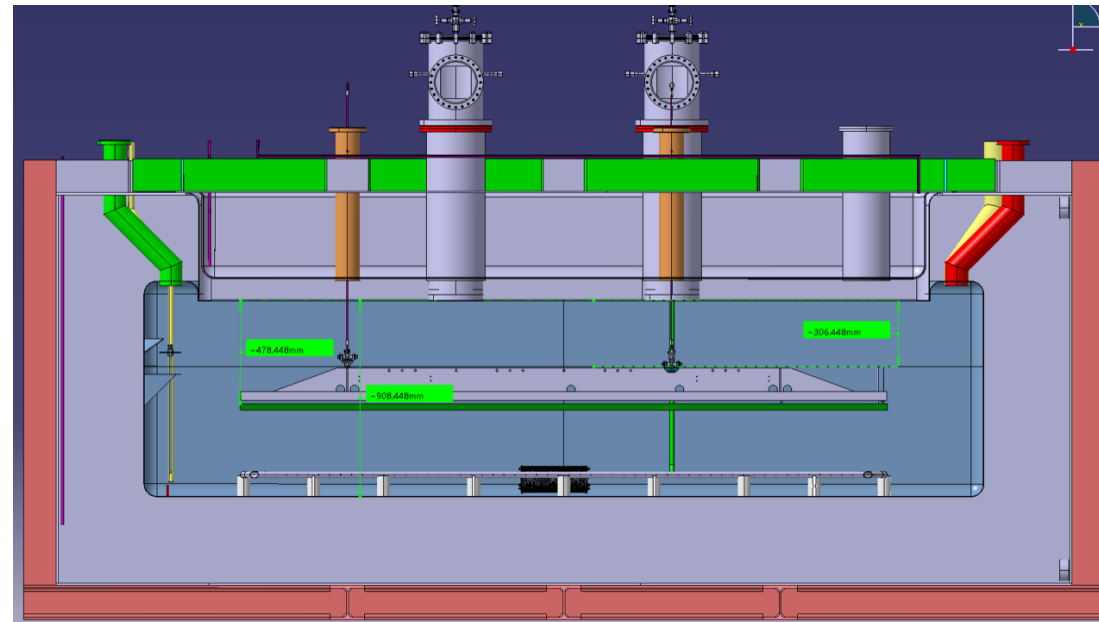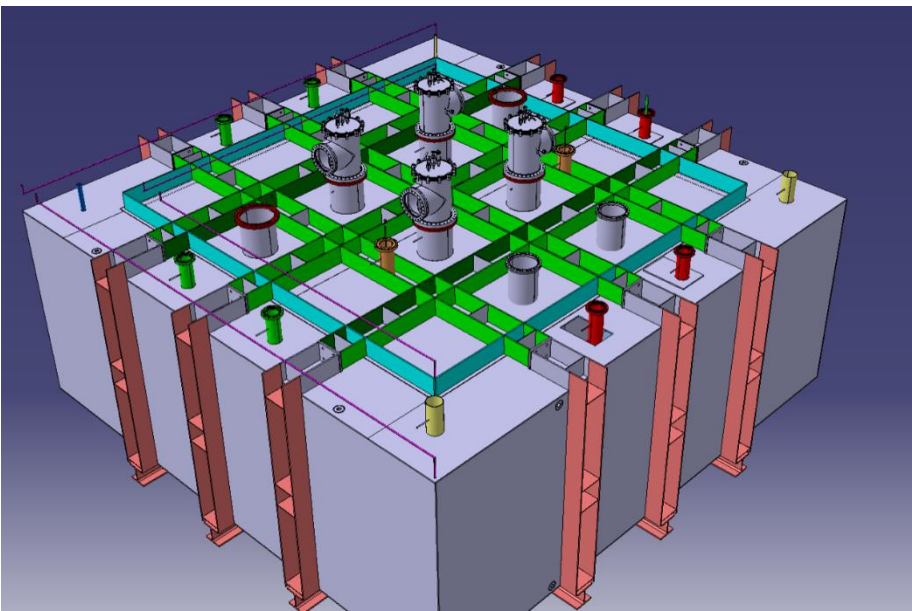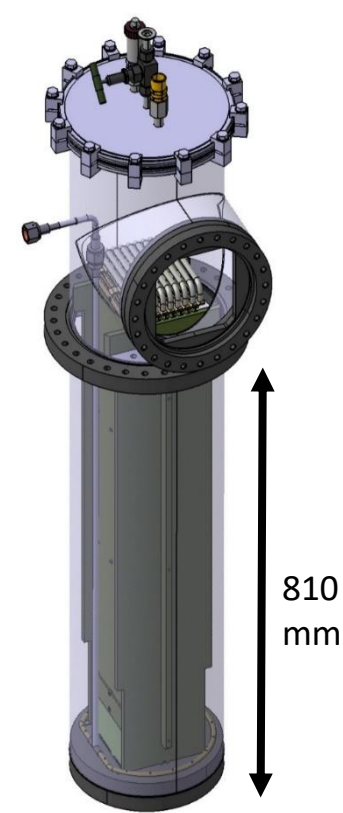
Chimneys for Vertical Drift

- Penetration diameter **from 250 to 480 mm**

- Able to house up to **50 FE boards** instead of 10

- **105 chimneys** to be produced

- Positioning of 50 connectors on Cold flange is possible with associated guiding system

- PCB design to be done

- Heat dissipation to be simulated

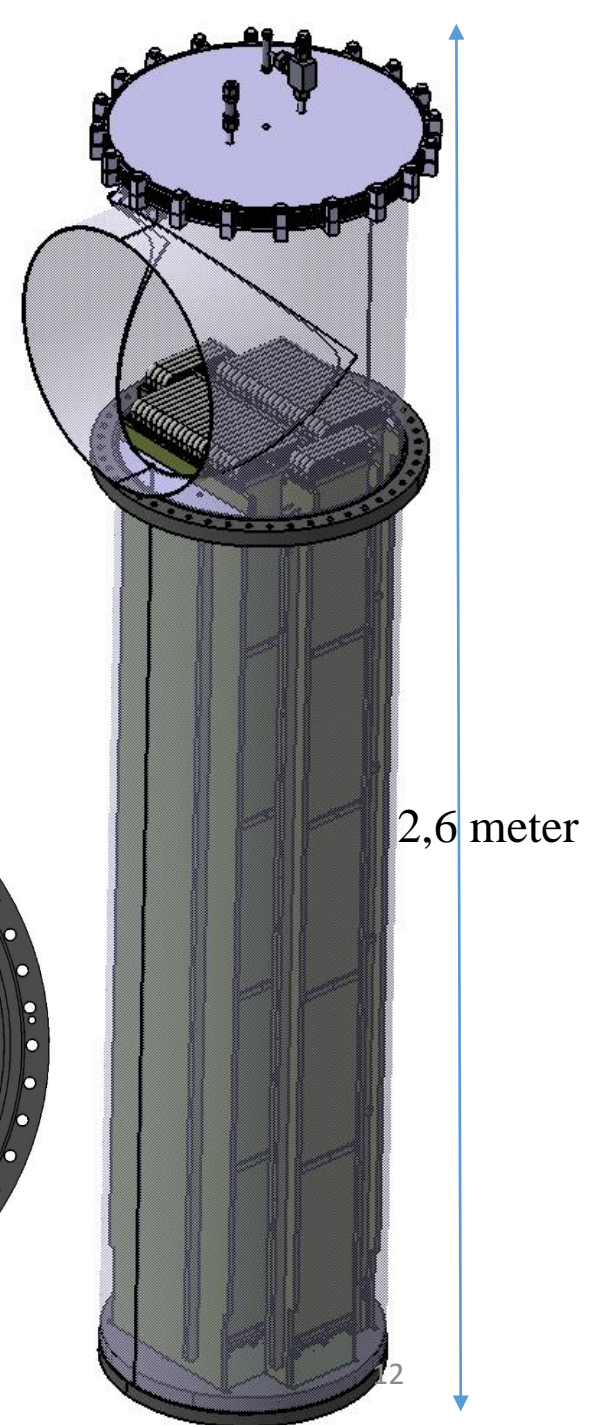- CAD file sent to I&I team to check potential problems with chimney height and handling

Top view

4

21   21

4
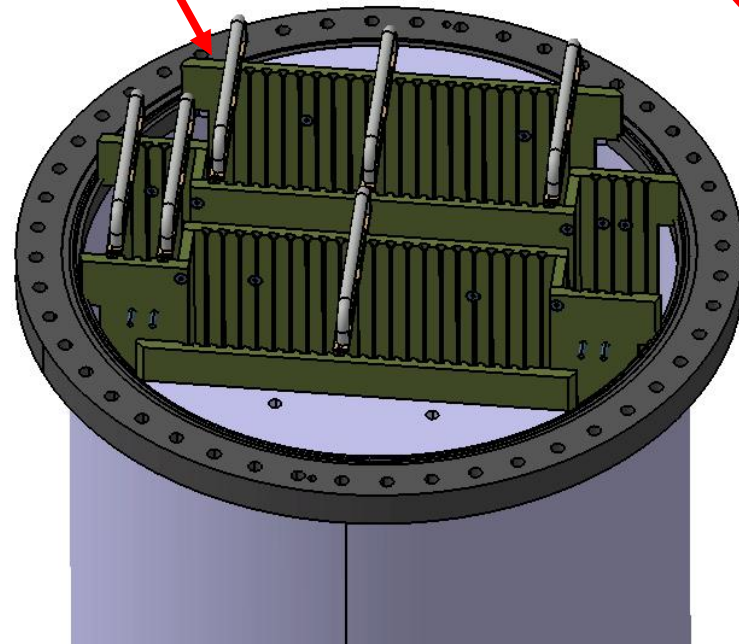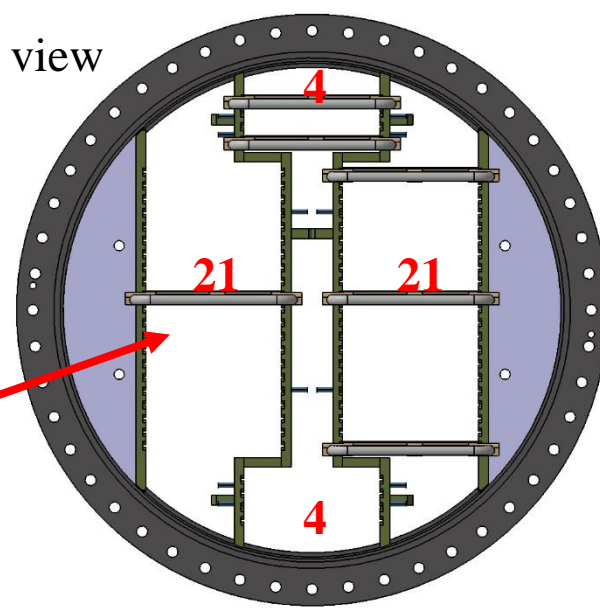
Perspective View at top

Bottom view

2,6 meter

12
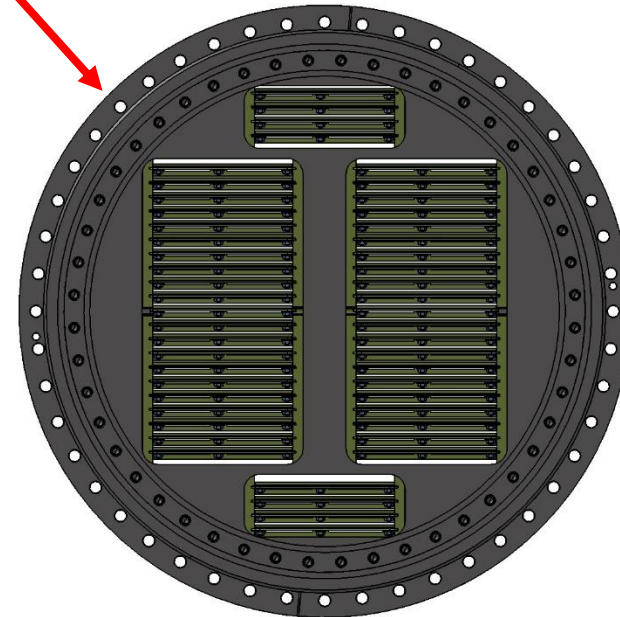
Conclusion

❑ DP Prototype
- Cold tests in Liquid Nitrogen
- **Handling of blades without problem**
- **88 K reached in the bottom part. Stable within 1 K**
- **Electrical continuity OK**
- Useful lessons for VD design

❑ Coldbox
- **Production in progress, almost ended (cleaning and leak tests to be performed next week**
- ⇒ Available at IJCLab in few weeks
- ⇒ At CERN before the end of June if needed

❑ First drawings for VD version
- **Solution for housing 50 boards** has been found
- Heat simulation to be performed in order to design the heat exchanger
- **Electronic engineer** identified for PCB design
- Interactions with I&I team for possible height and handling issues