TPC cooling system – status 02_07_2019

1. TPC cooling scheme and requirements

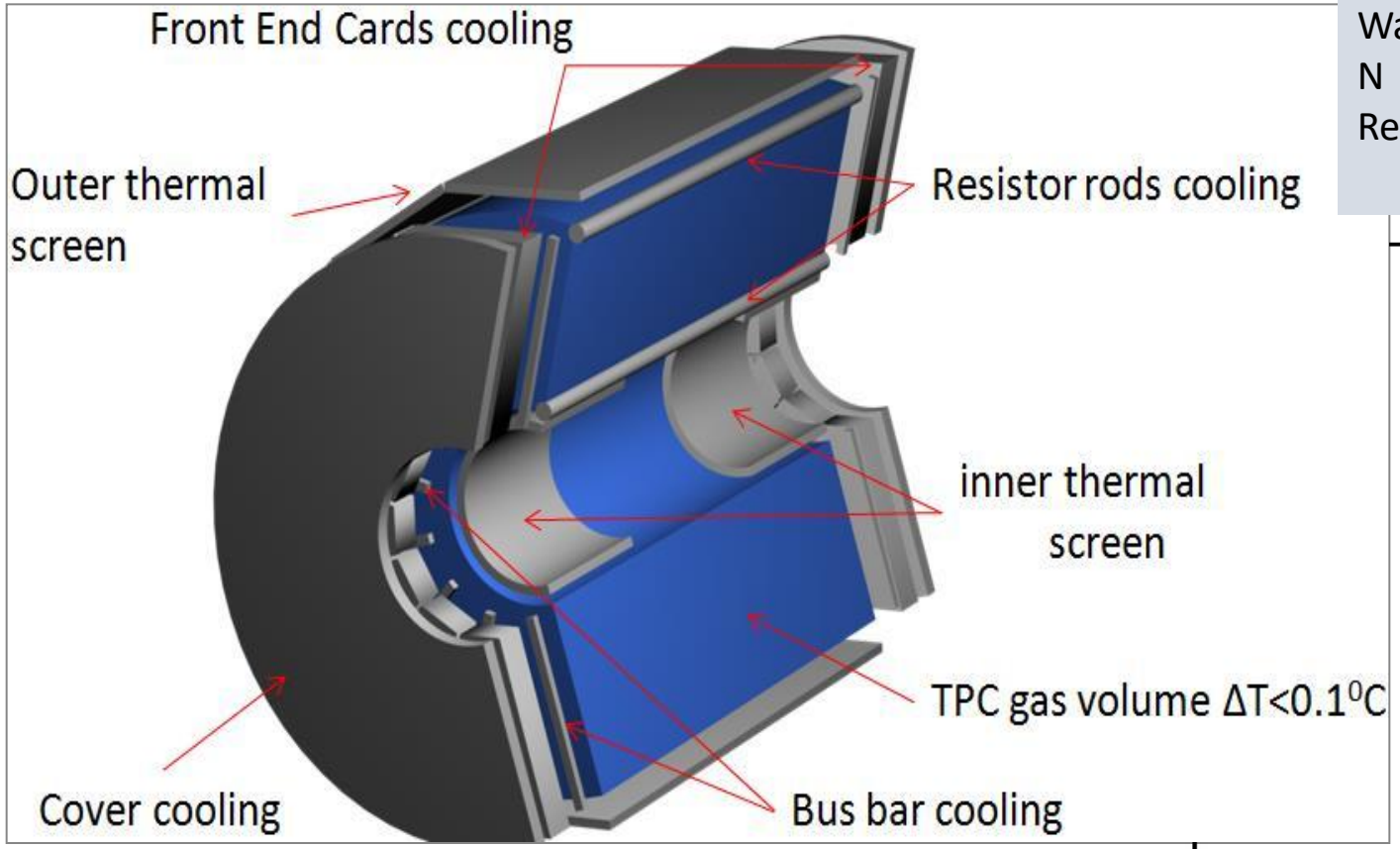
2. cooling ROC tube 6x4 mm
3. cooling FEC tube 3x2
4. cooling LVDB tube 6x4
5. cooling inner thermal screen tube 6x4
6. cooling front thermal screen tube 10x8
7. cooling outer thermal screen tube 10x8

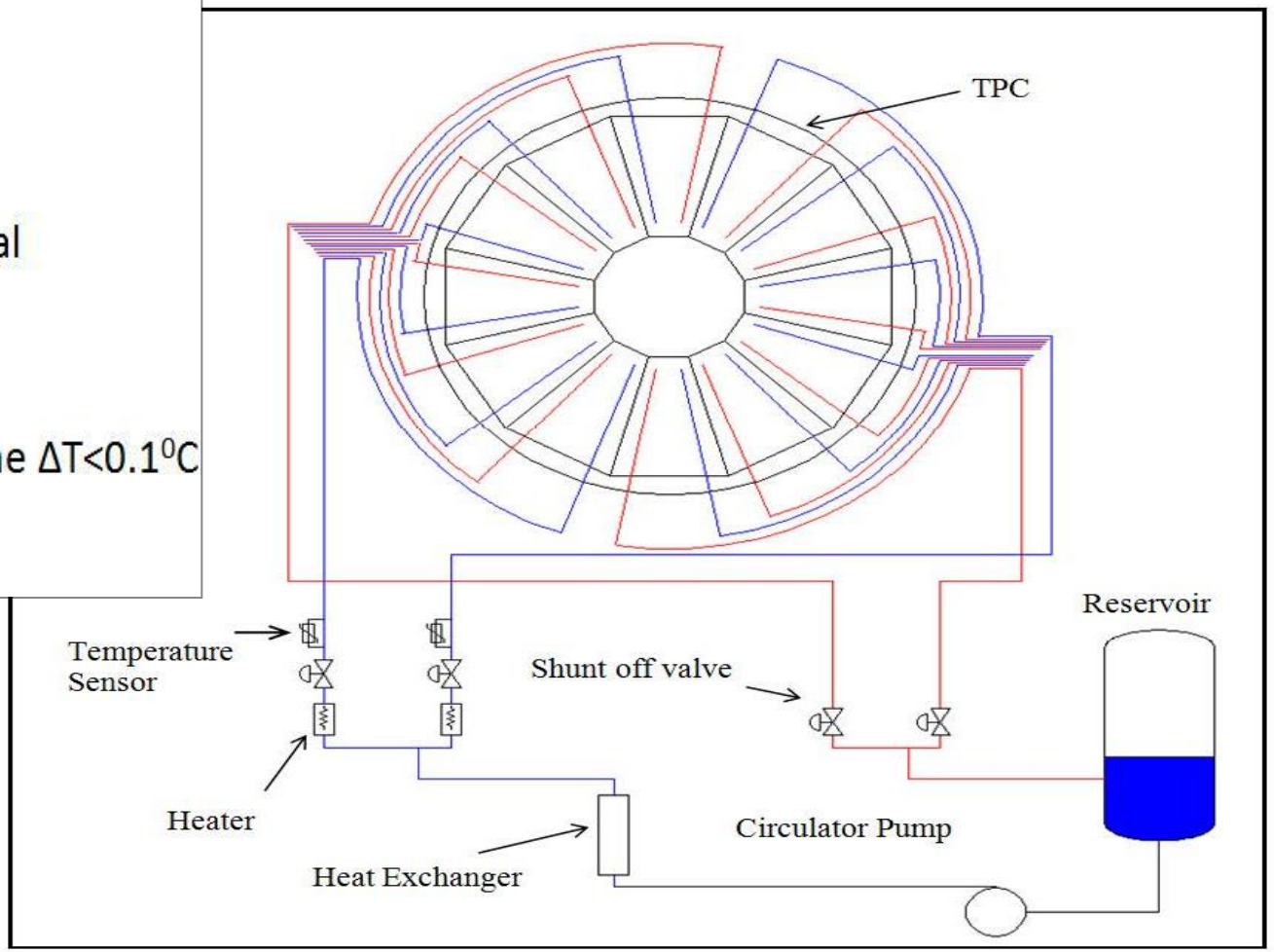
Manifold tubes for all cooling systems - 18x16 mm.
Supply tubes inside the MPD for all manifold systems - 30x20 mm. (Flexible Tube, bellow).

8. FE electronics cooling

TPC cooling system

Total power P ~ **10 kW**
System type – low pressure (NO water leak)
Water in: T=18 degree, expected water out: T=(25-27) degree
Water flow=(40÷60)m3/h -> **up to 1 m3/min**
N of controlled cooling channels – about **N=72pc**
Requirements for TPC gas volume temperature stabilization:
T=(To **+/- 0.25)** degree

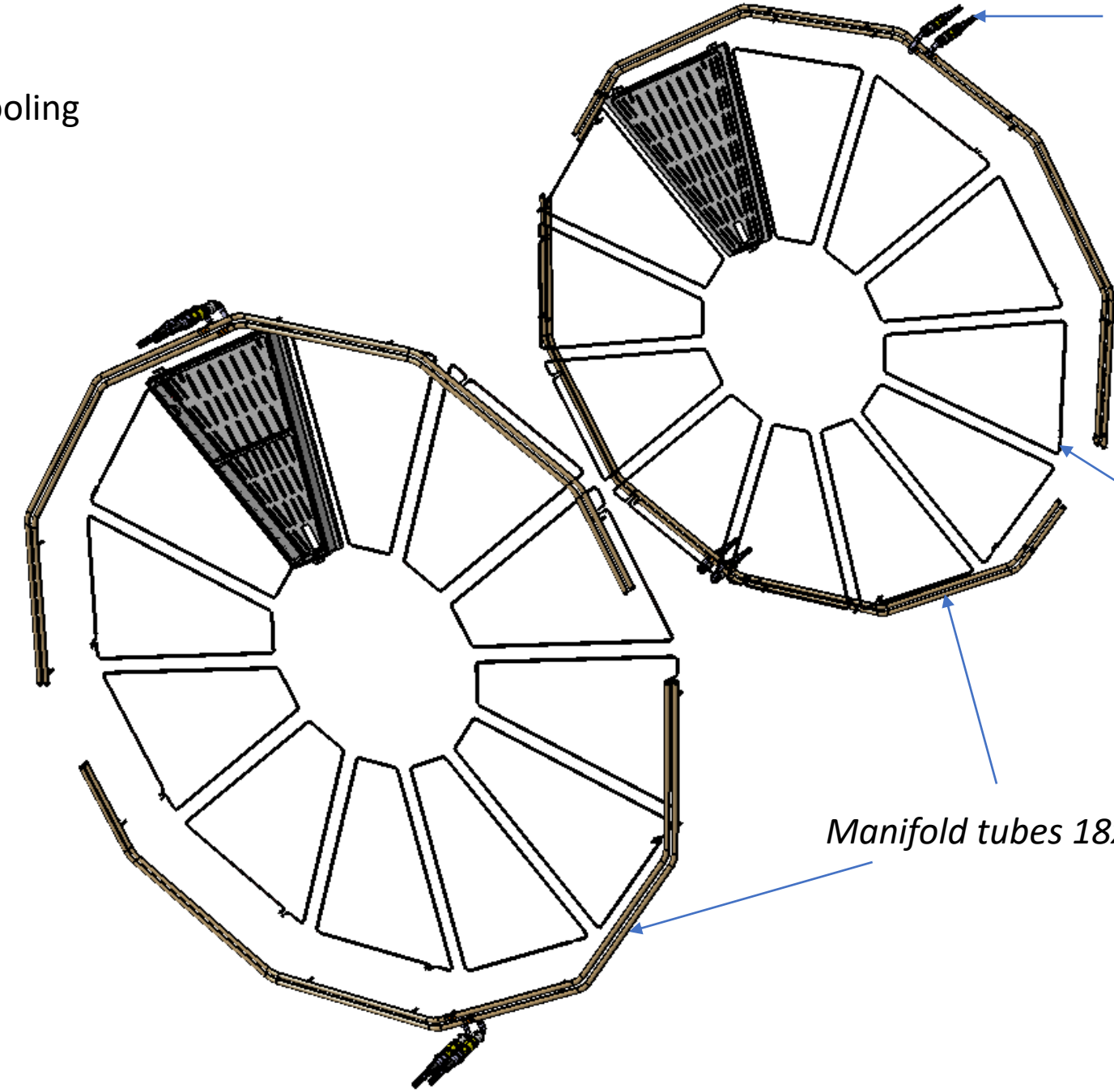




3-Jul-19

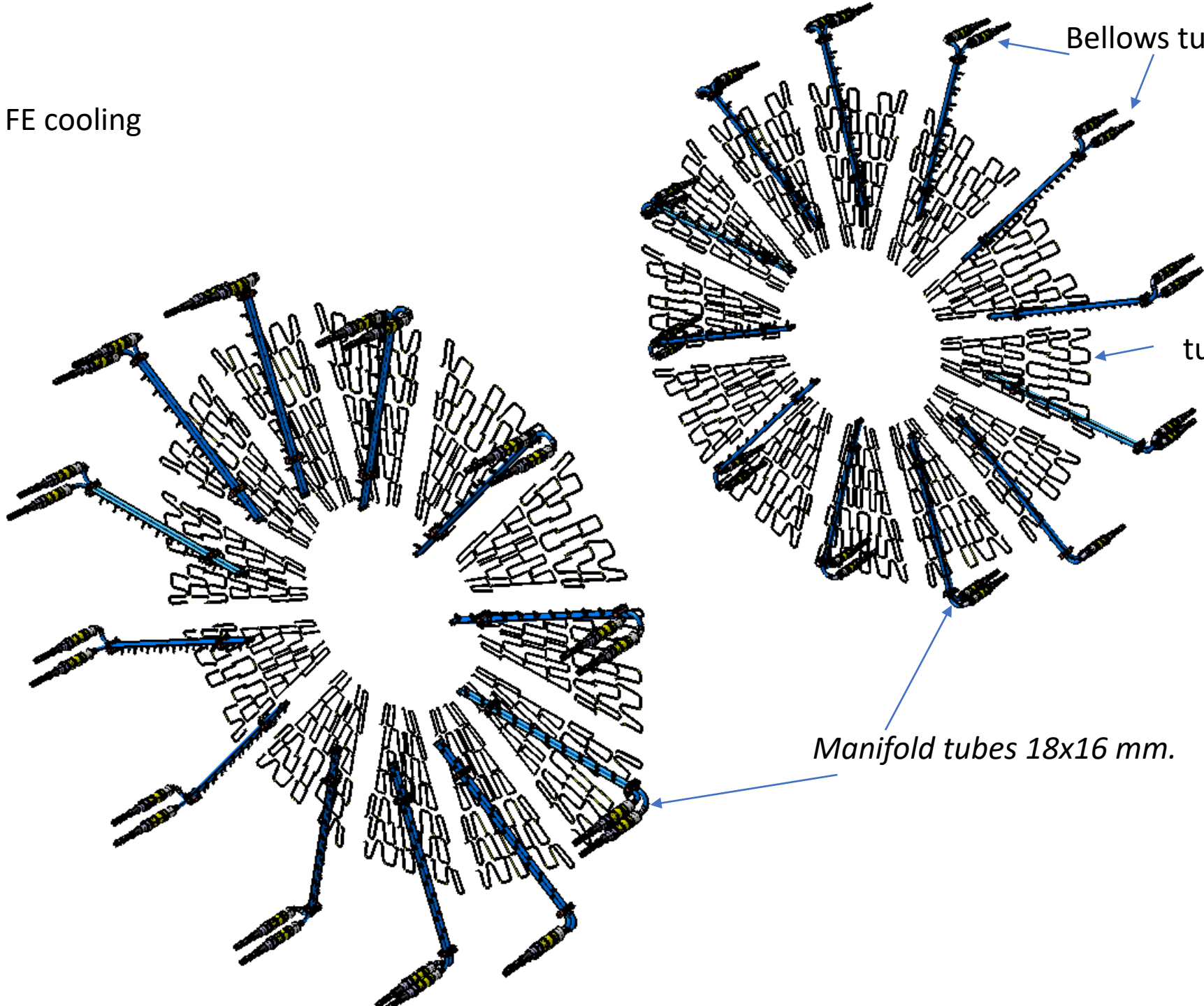
TPC ROC chambers and electronics cooling

ROC cooling



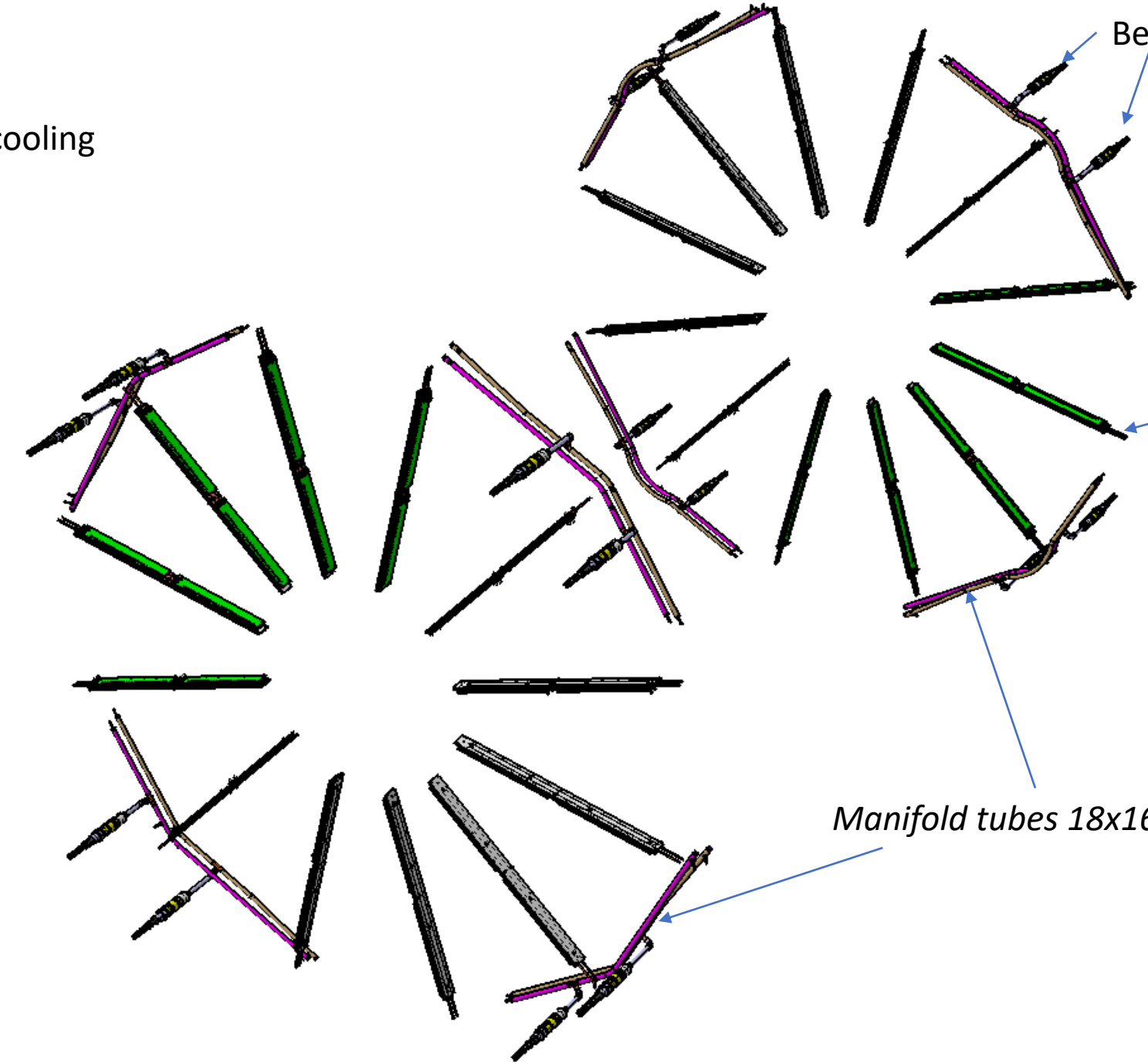
4 channels

FE cooling



24 channels

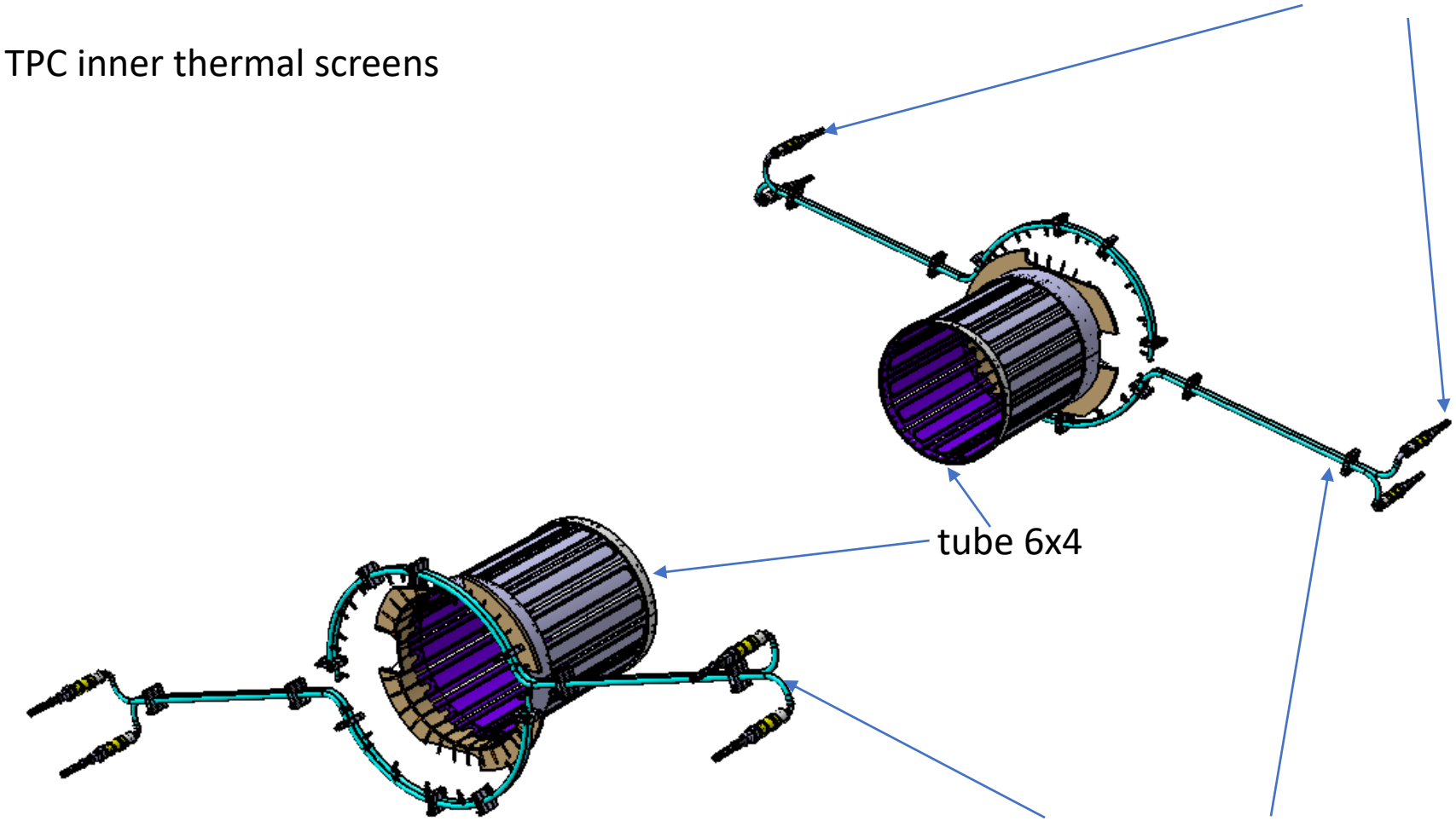
LVDB cooling



8 channels

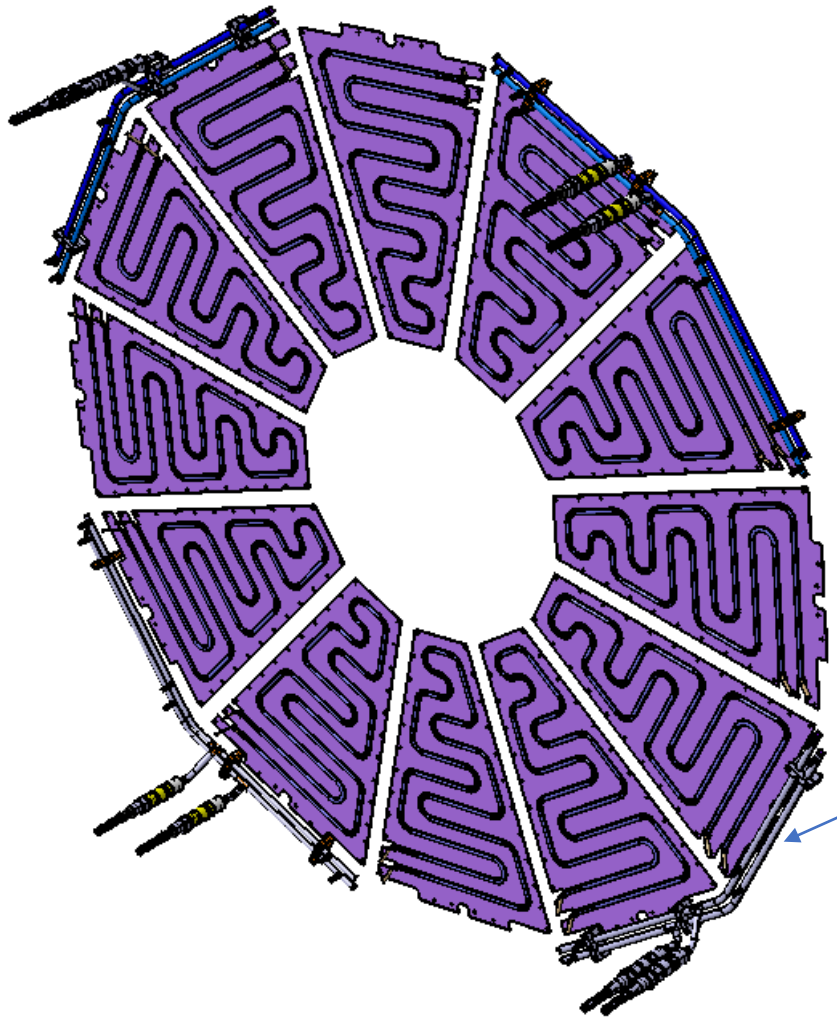
TPC thermal screens

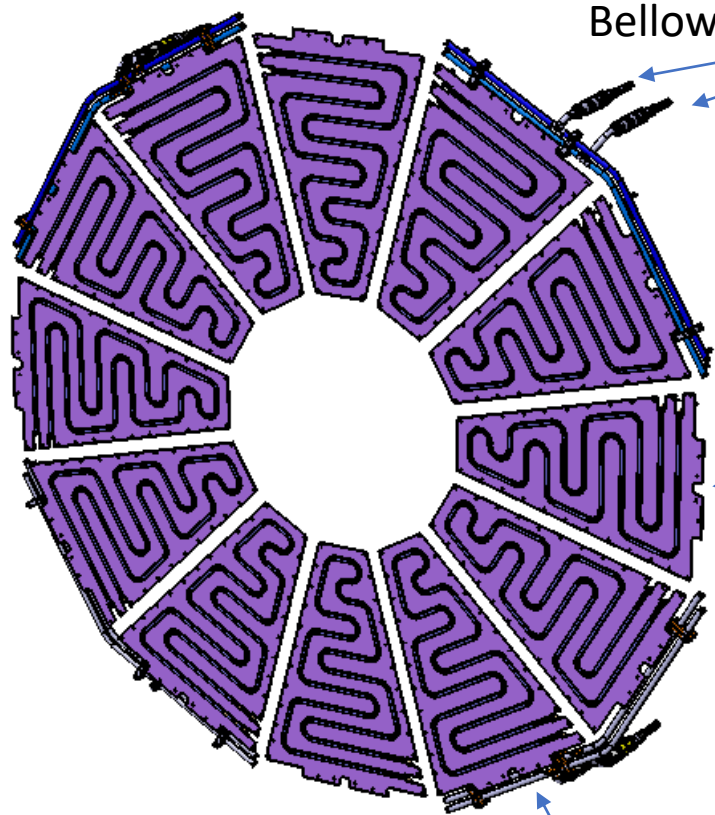
TPC inner thermal screens



4 channels

TPC front thermal screens





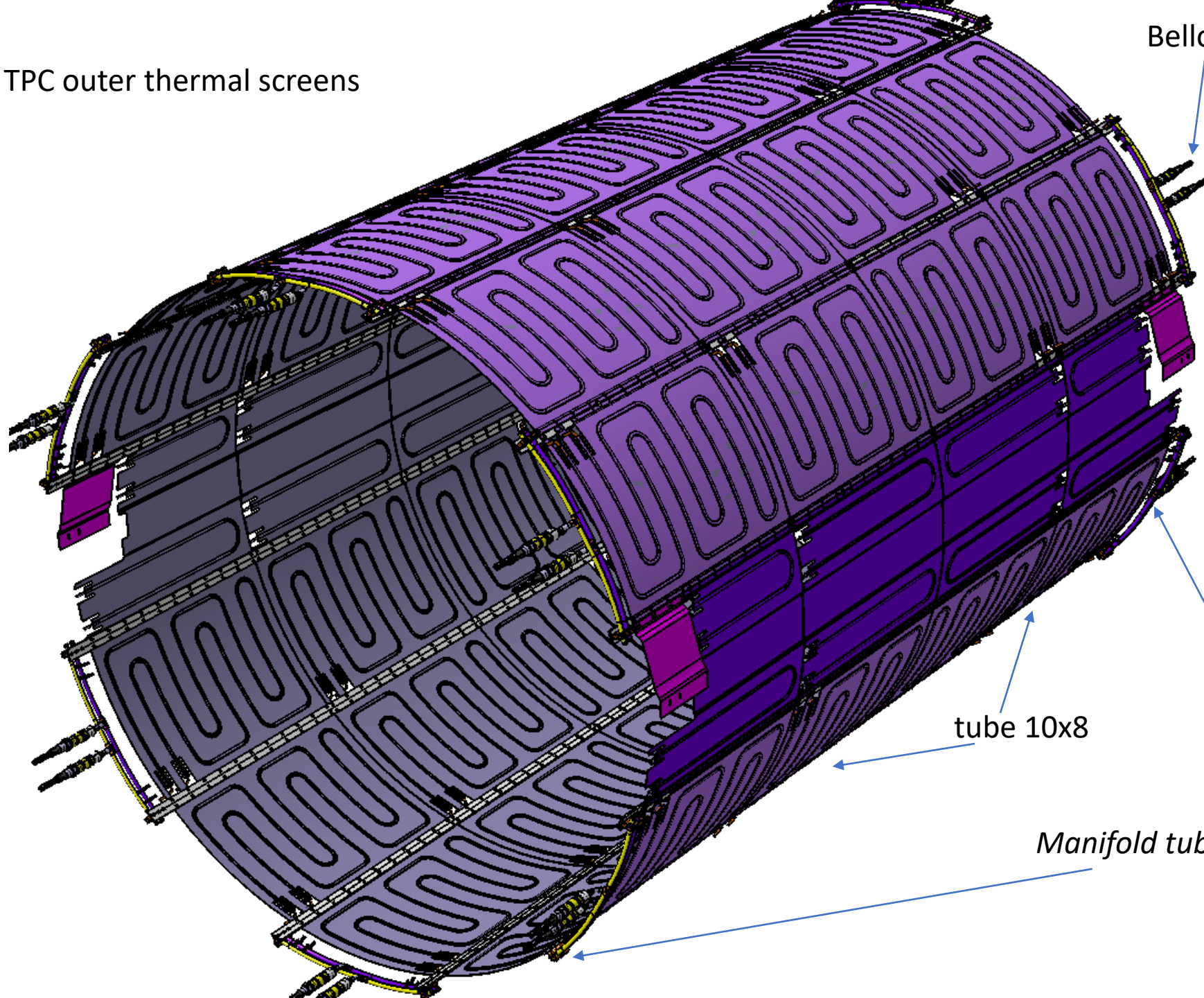
Bellows tubes 30x20 mm

tube 10x8

Manifold tubes 18x16 mm.

8 channels

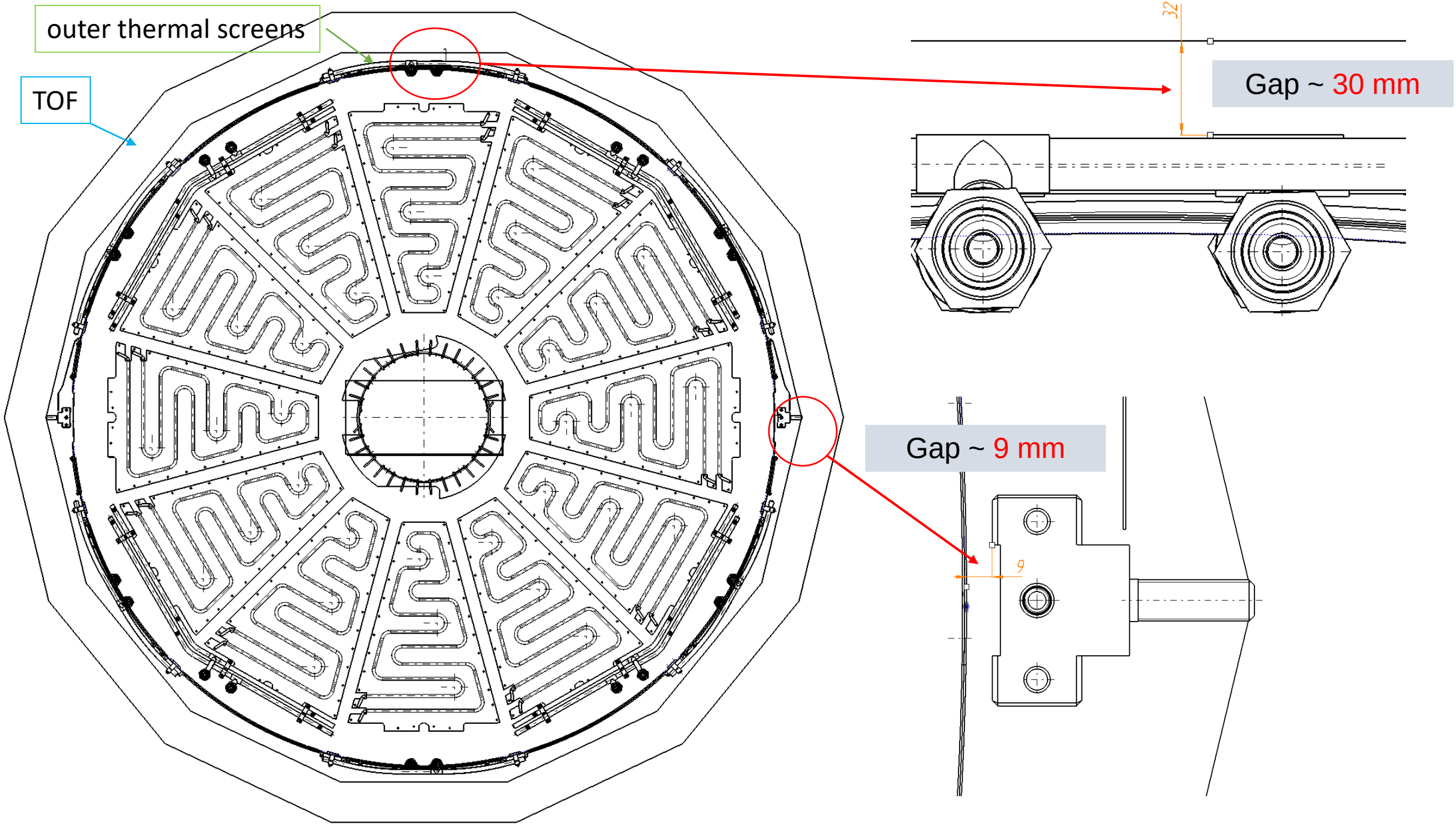
TPC outer thermal screens



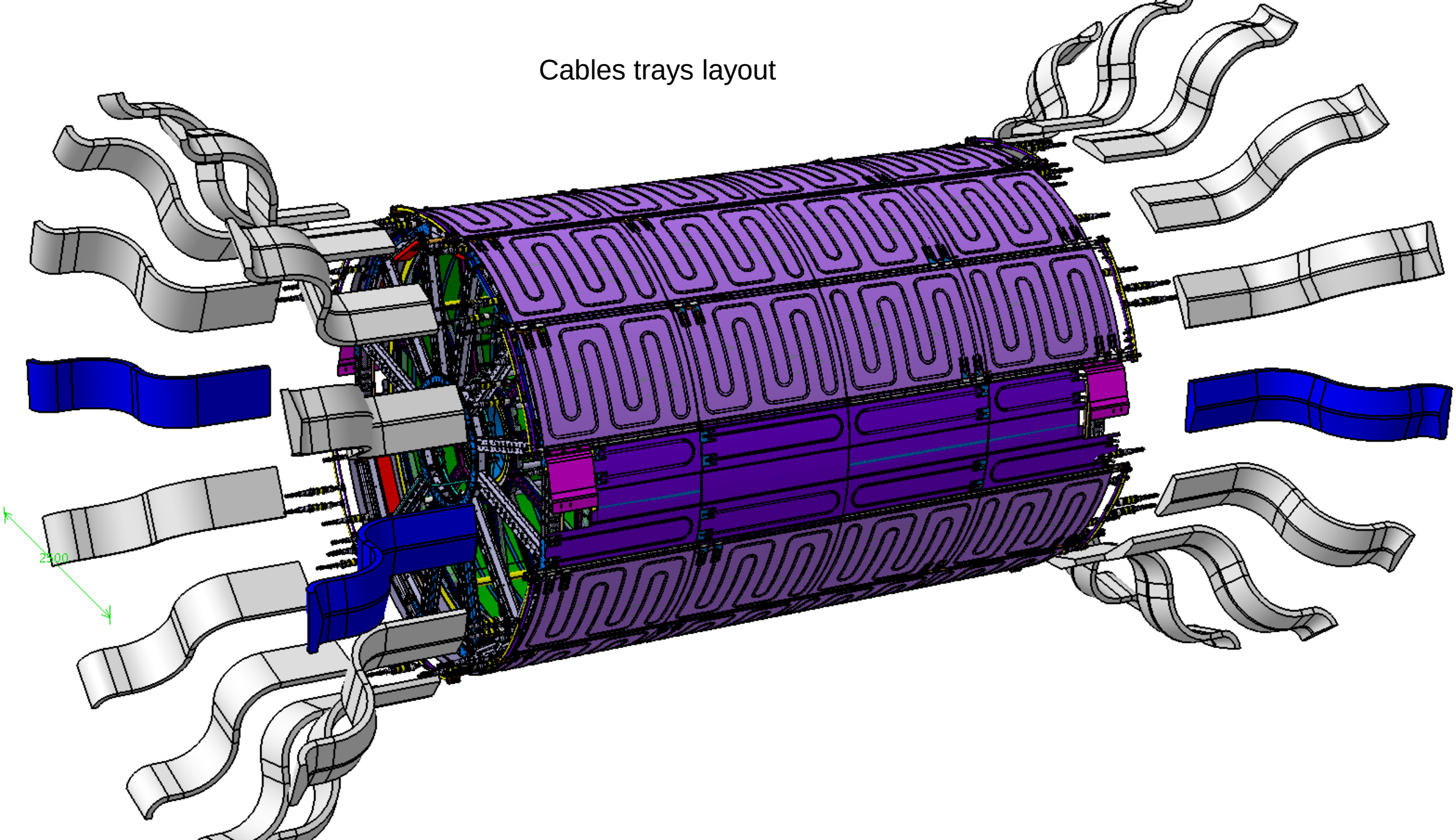
Summary (number of controlled cooling channels):

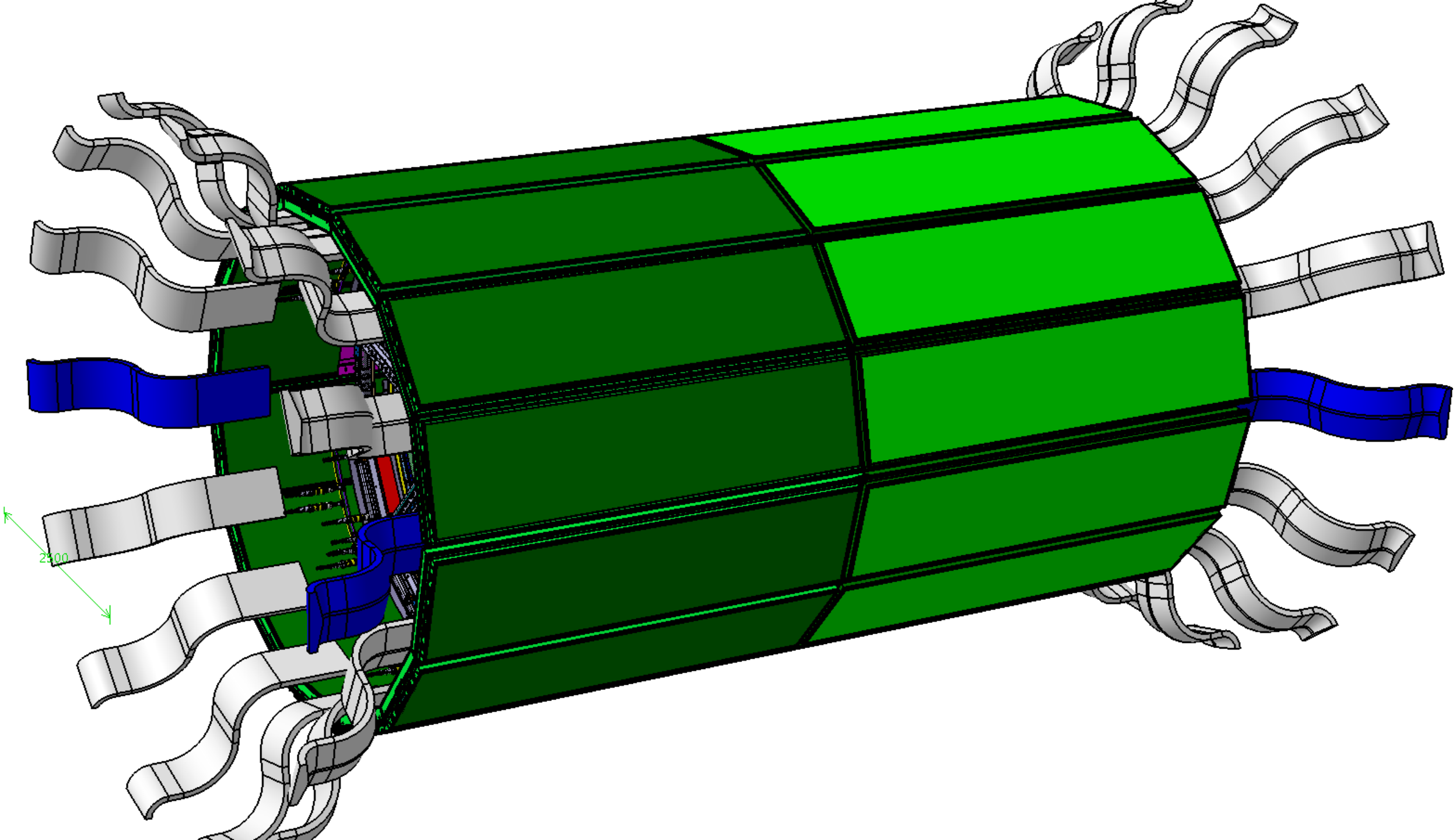
		N controlled channels
1. cooling ROC	tube 6x4 mm	4 channels
2. cooling FEC	tube 3x2	24 channels
3. cooling LVDB	tube 6x4	8 channels
4. cooling inner thermal screen	tube 6x4	4 channels
5. cooling front thermal screen	tube 10x8	8 channels
6. cooling outer thermal screen	tube 10x8	12-24 channels

Total: **up to 72 channels**
(control water temperature and water flow)


outer thermal screens
TOF
32
Gap ~ 30 mm
Gap ~ 9 mm
9

Cables trays layout

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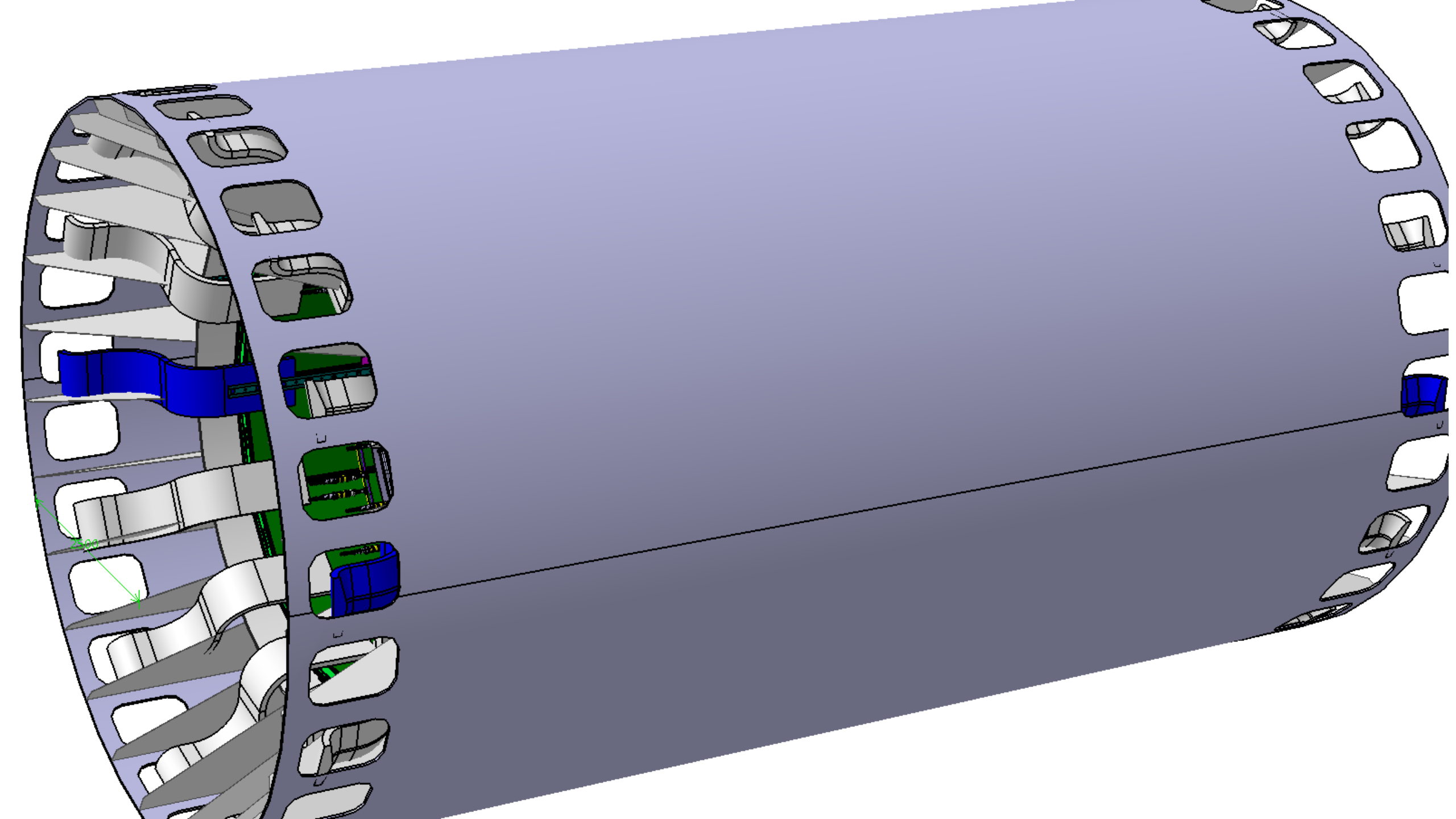
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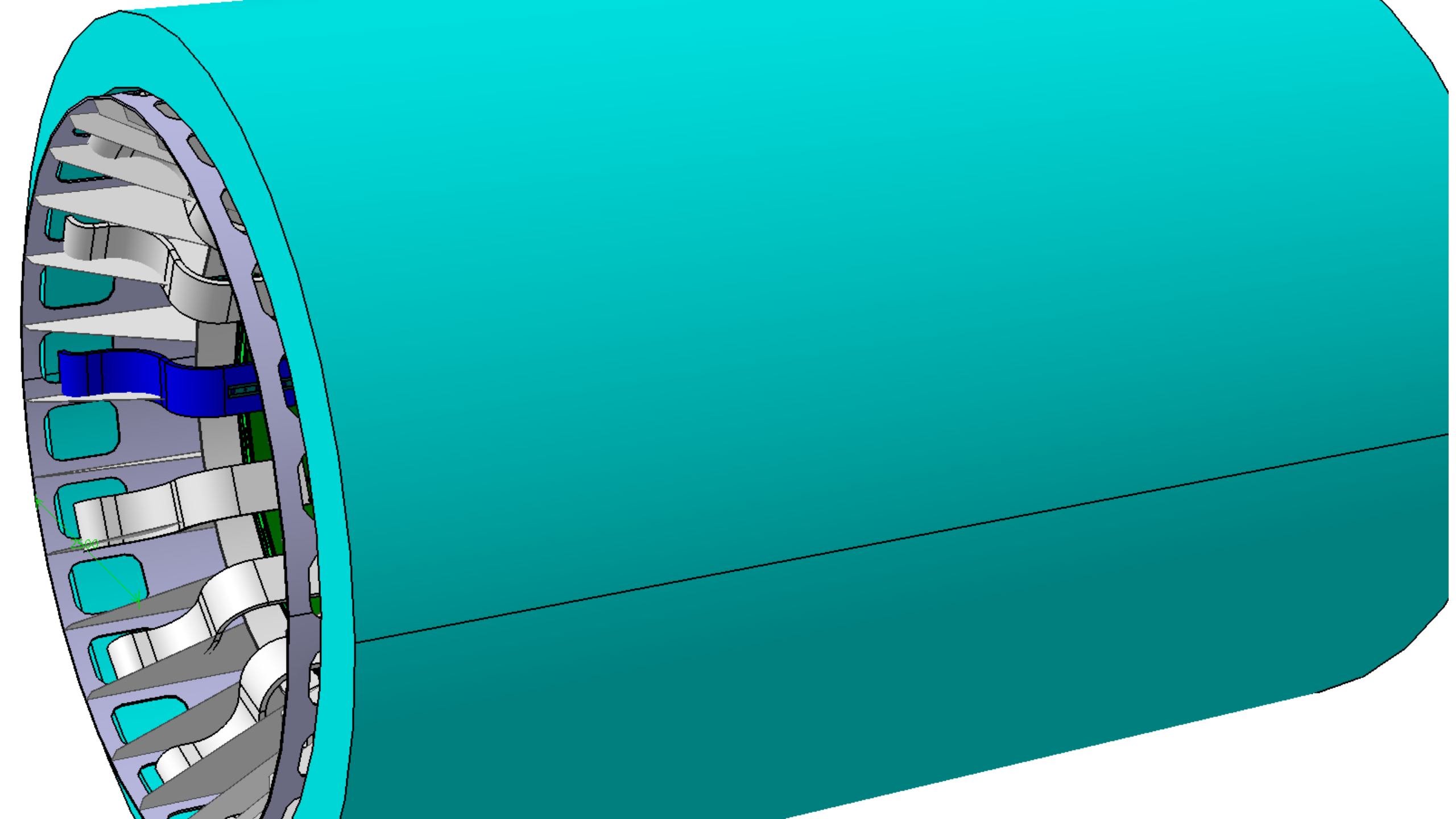
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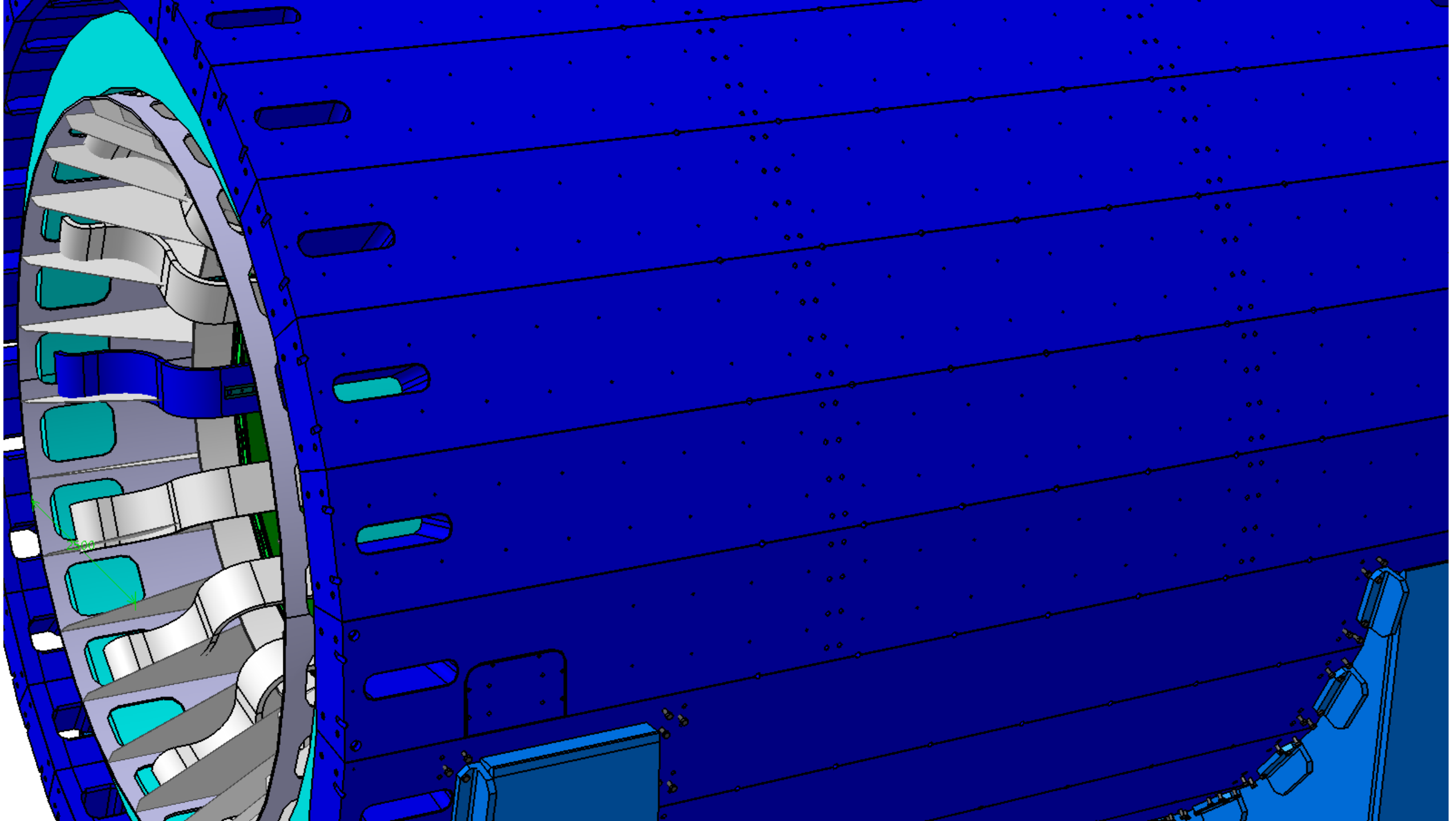

2500

TPC FE electronics cooling system design

Power per ROC chamber:

FE boards (62pc) – 220 W

(SAMPA board – 1.5 W + r/o board (FPGA) – 2 W)

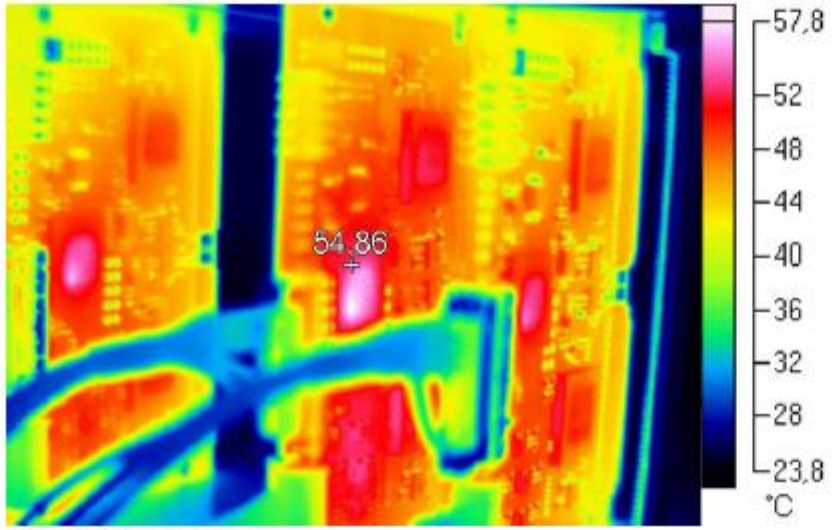
LVDB (2 pc) - 150 W

Controller - 30 W

Total per chamber - 400 W

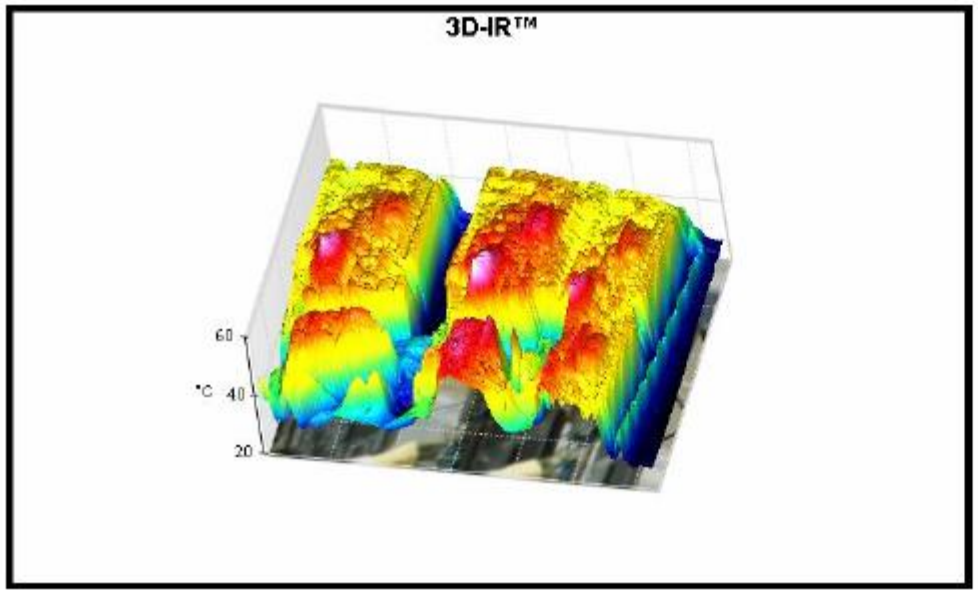
Total per TPC (24 ROC chambers) ~ 10 kW

Измерения температуры FE карты (old design) тепловизором



IR_00019.IS2

Изображение в видимом свете

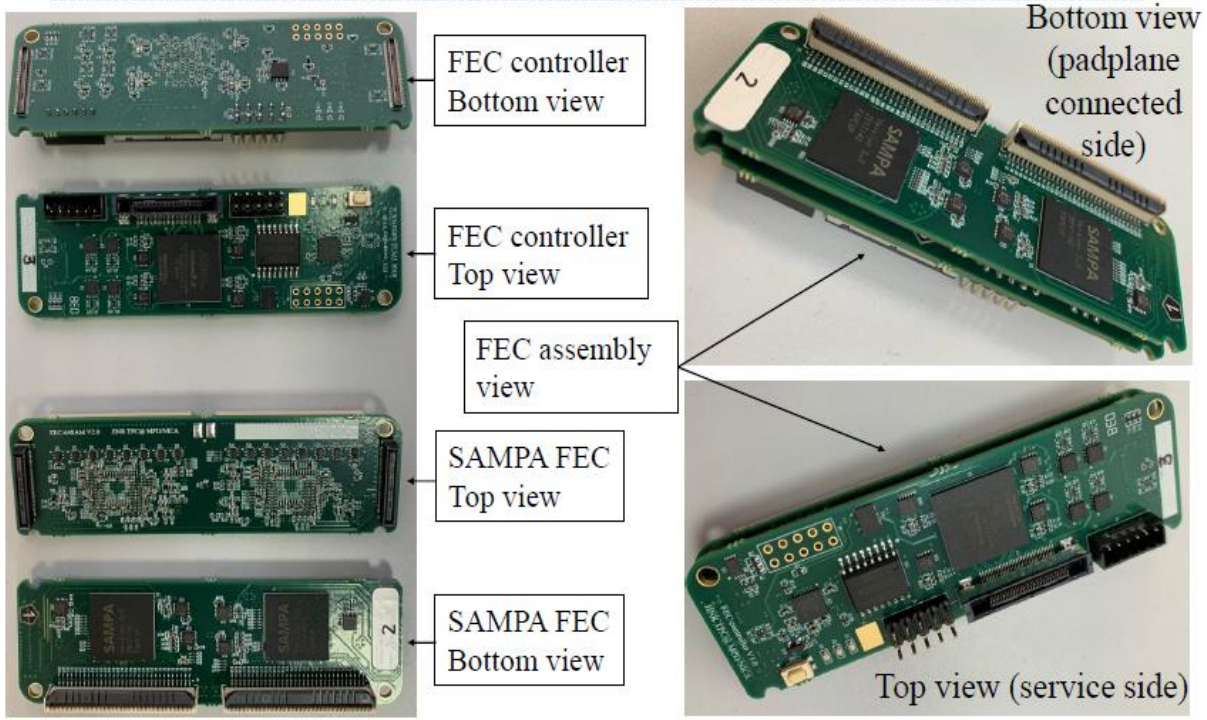


Only convectional cooling by air:

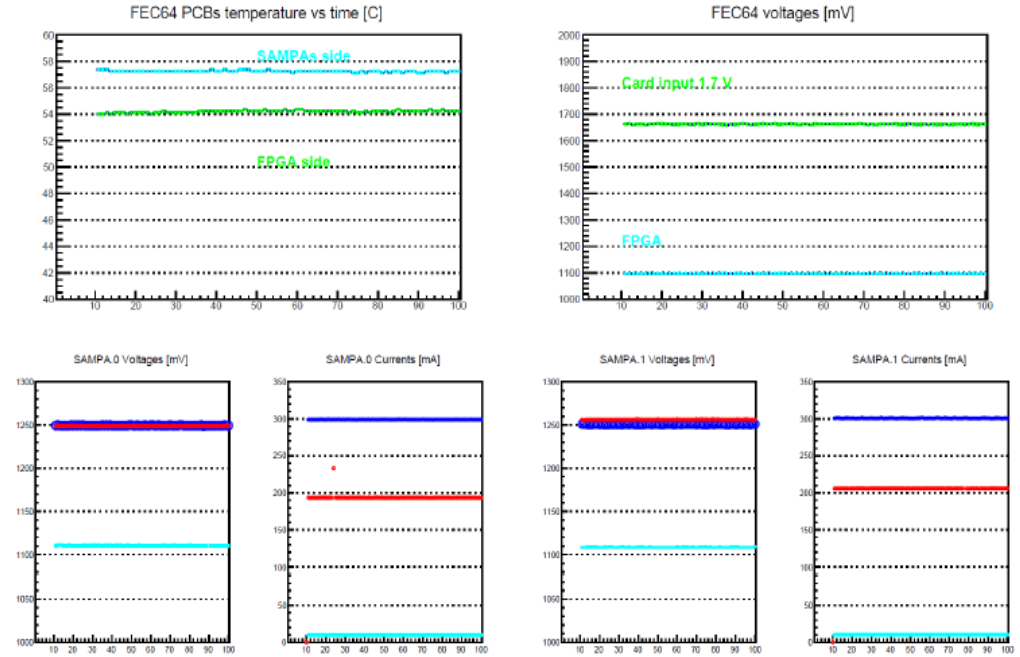
T_{SAMPA} ~ 50 degree

T_{FPGA} ~ 55 degree

TPC electronics: FE cards



FEC slow control data



Only convectional cooling by air =>

Slow control data:

T_{SAMPA} = 57 degree

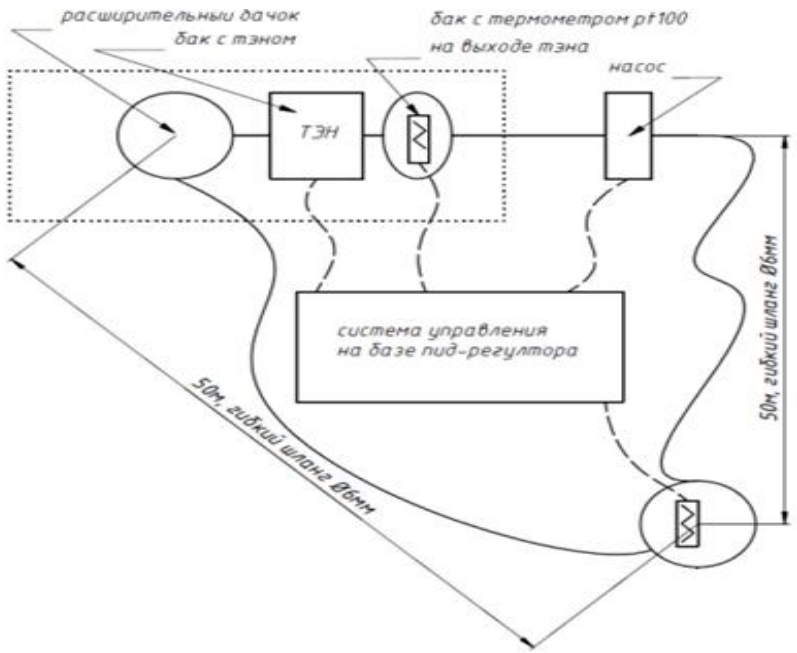
T_{FPGA} = 54 degree (stand by mode)

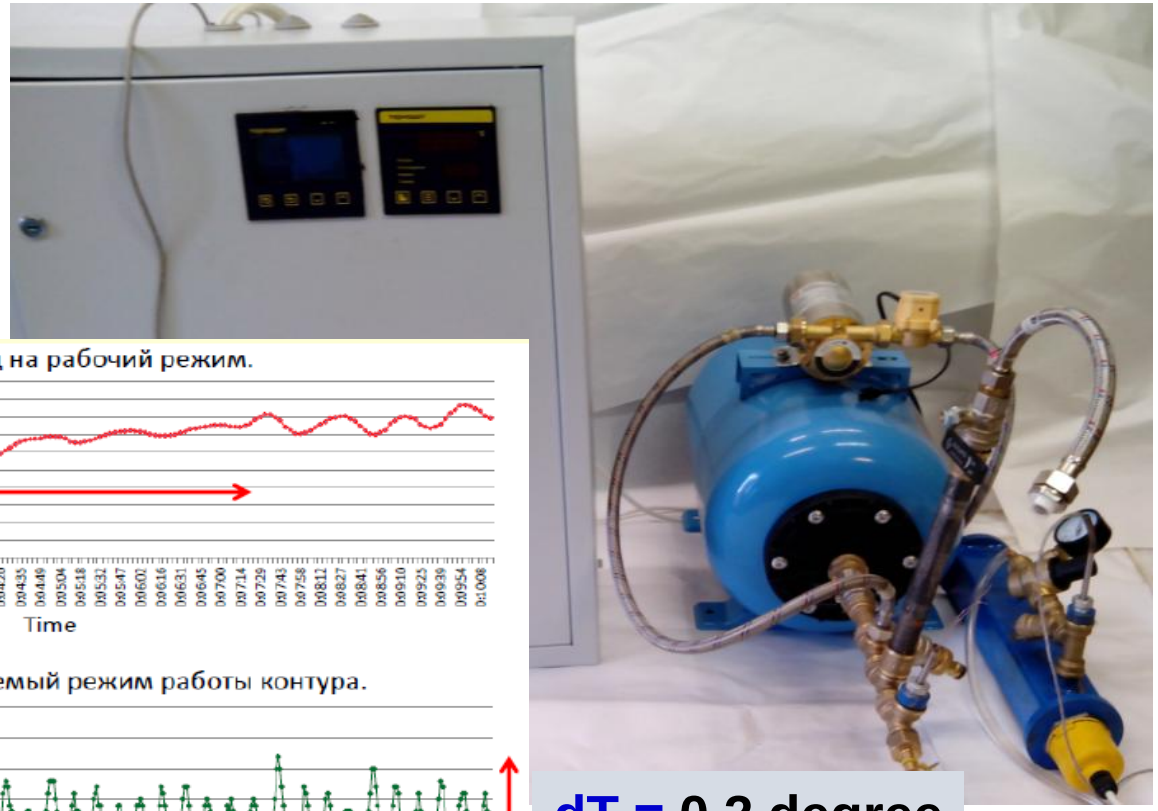
Board LV: 1.7V & 1.1V

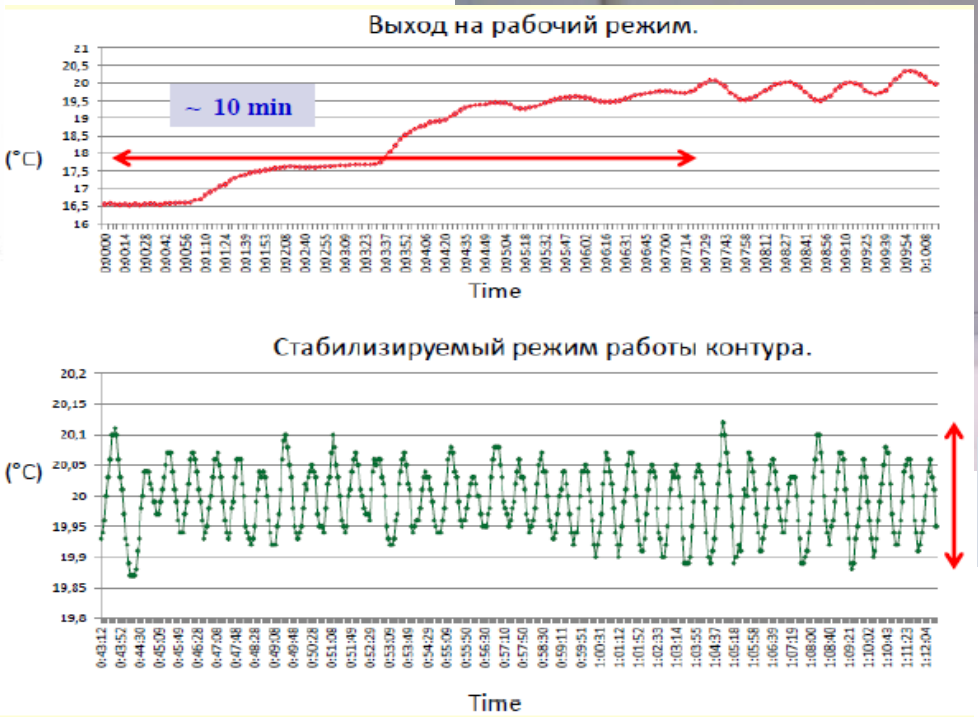
SAMPA : 1.25V/500 mA

FPGA: 1.1V/10 mA (stand by mode)

Cooling system: prototype status



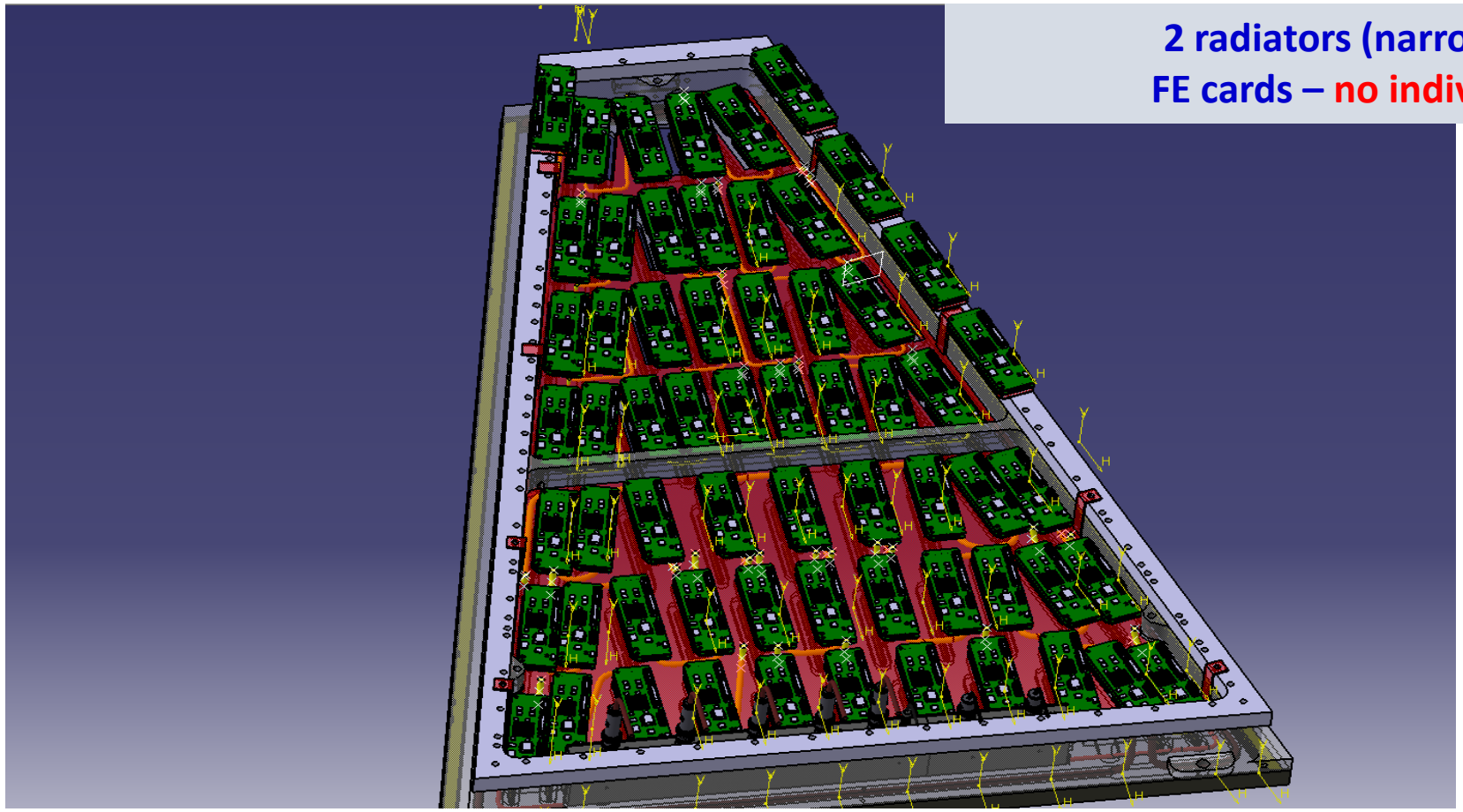




dT = 0.2 degree
(requirement: dT=0.5)

in progress …

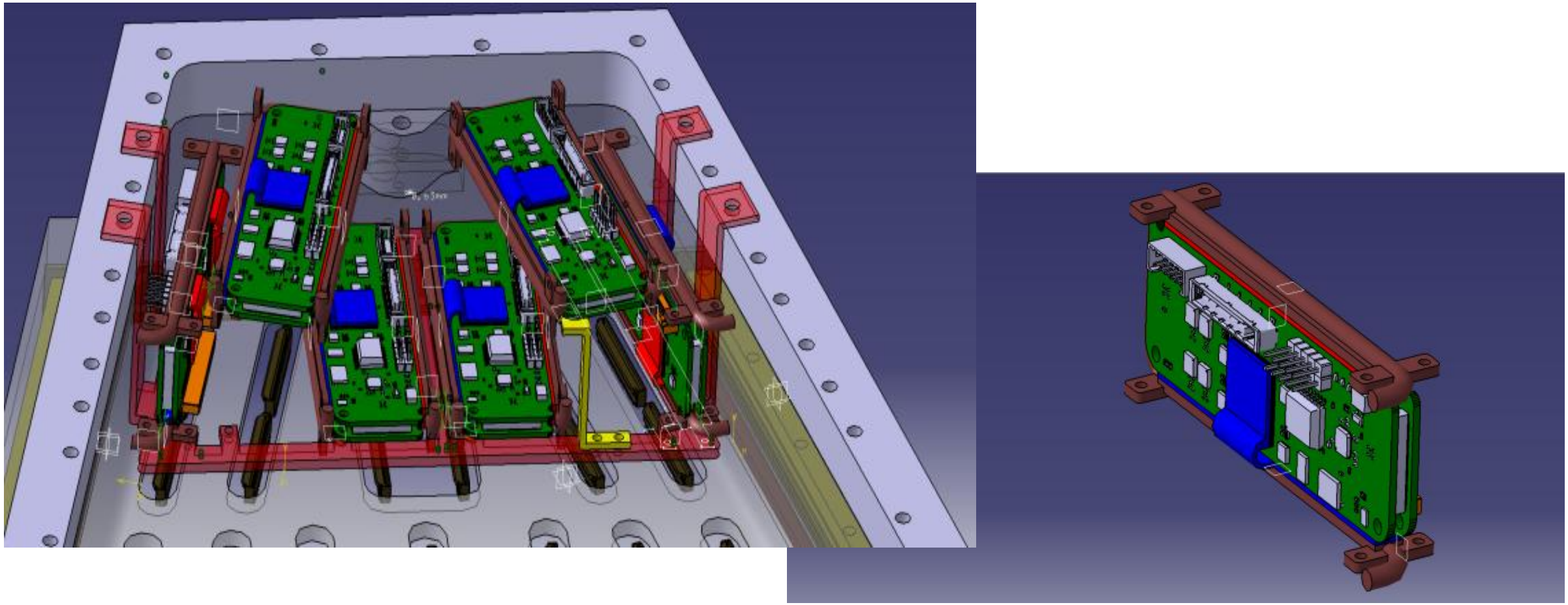
TPC electronics: FE cards integration and cooling (option 1 – base line)



2 radiators (narrow and wide)
FE cards – no individual cooling

Status: in progress

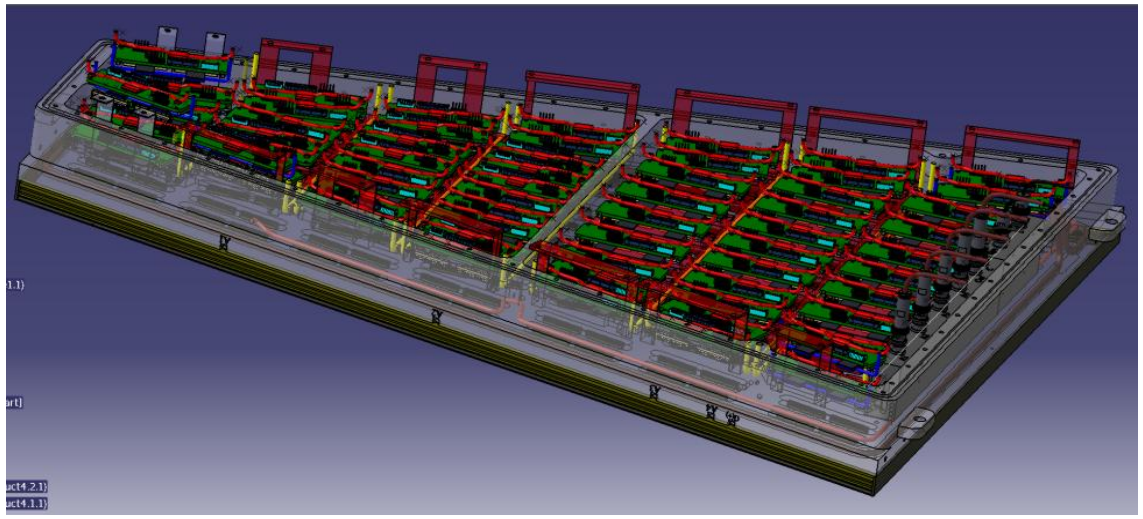
TPC electronics: FE cards integration and cooling (option 2)

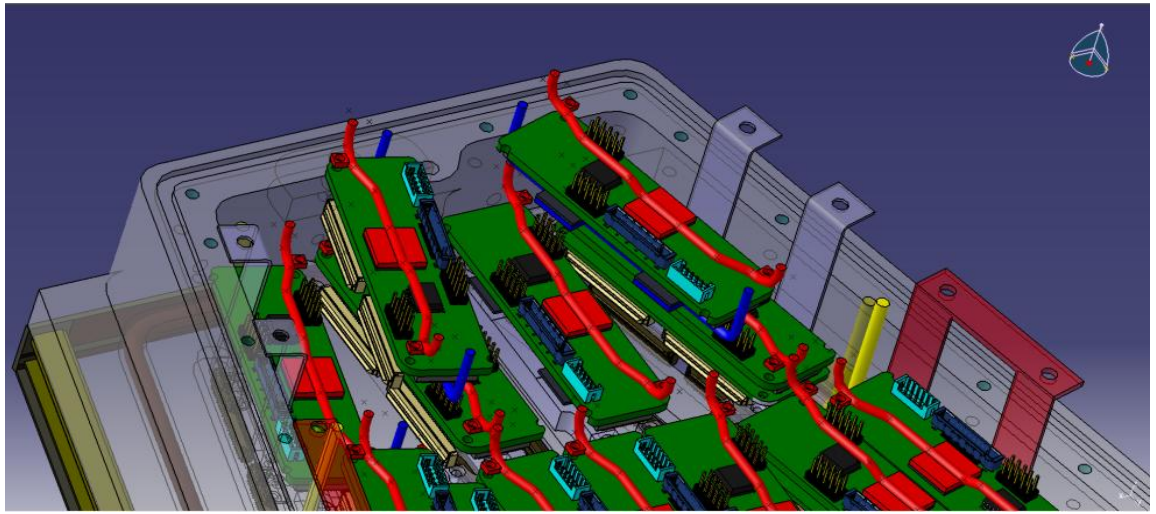


Both FE cards cooling by tube

Status: in progress

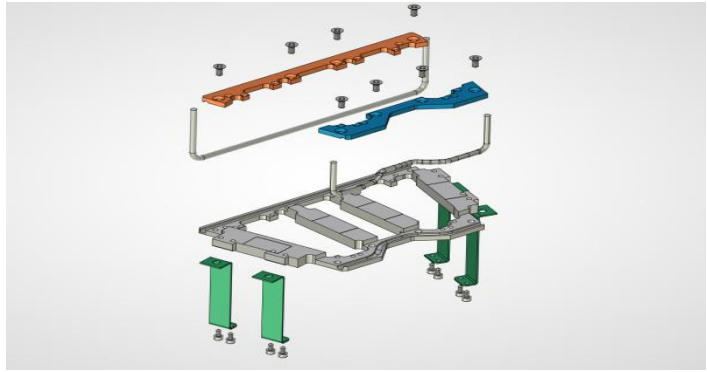
TPC electronics: FE cards integration and cooling (option 3)

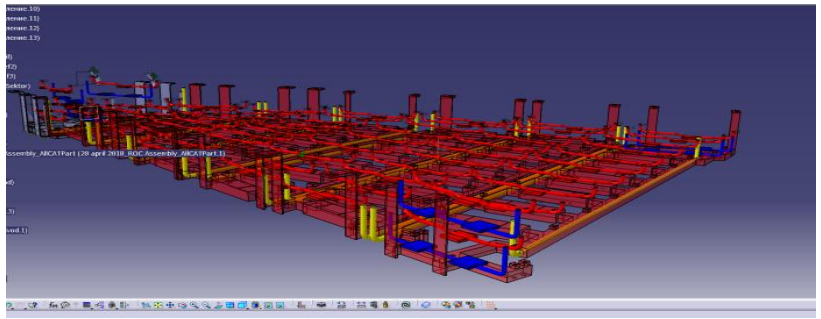


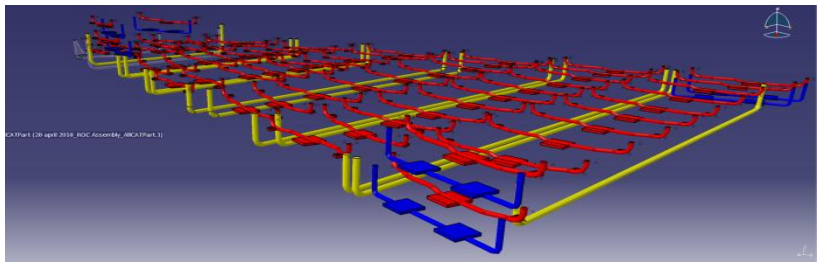


Many radiators (8pc):

- **SAMPA chips - cooling by radiator**
- **FPGA chip – cooling by metal pad with tube**



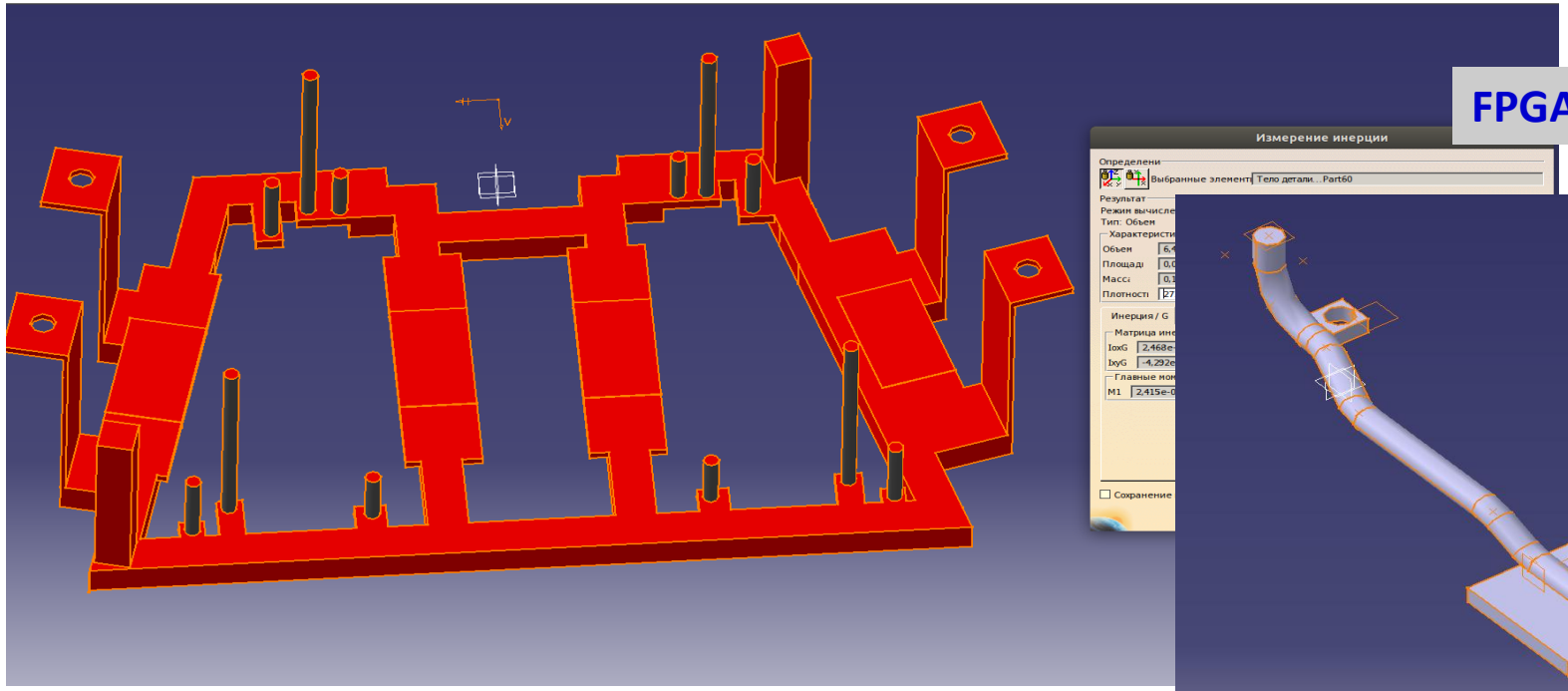




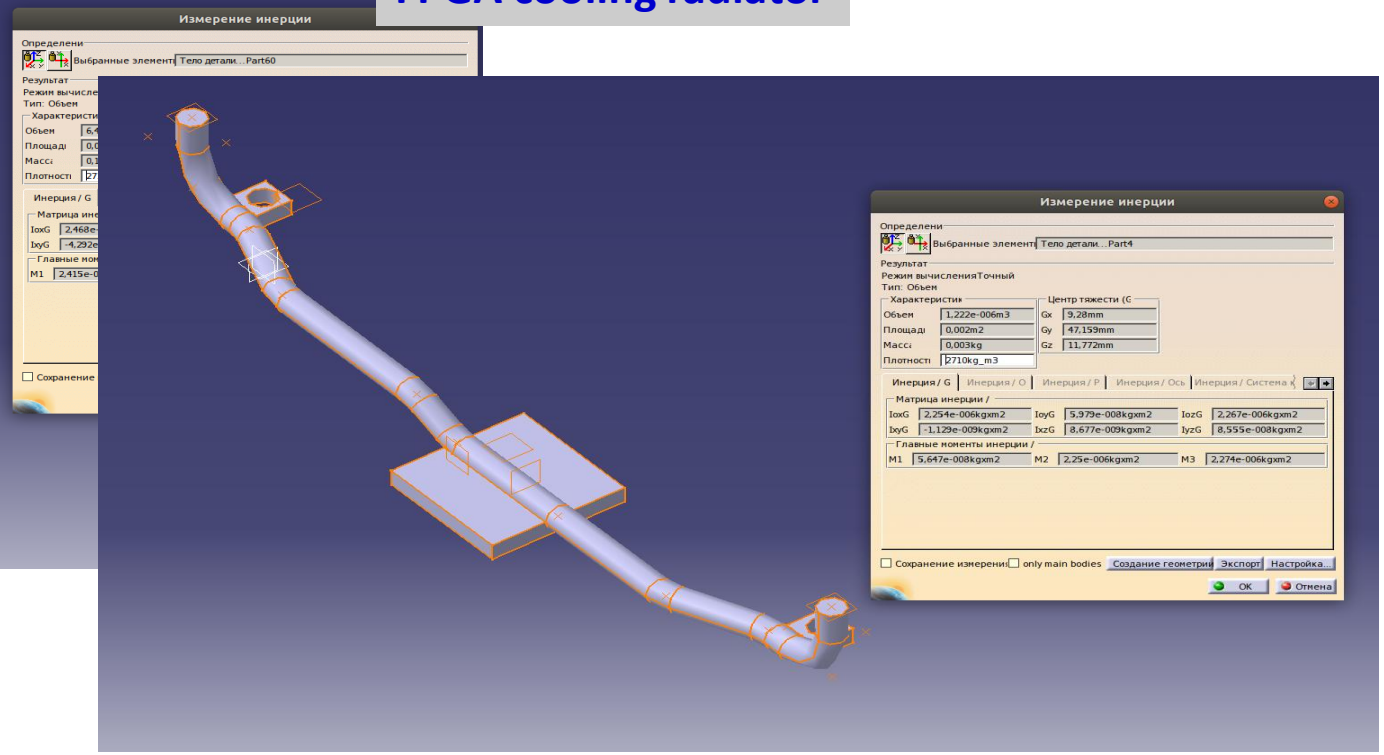
Status: in progress

TPC electronics: FE cards integration and cooling (option 3)

SAMPA cooling radiator



FPGA cooling radiator



Summary:

Total power P ~ **10 kW**
System type – low pressure (NO water leak)
Water in: T=18 degree, expected water out: T=(25-27) degree
Water flow=(40÷60)m3/h -> **up to 1 m3/min**
N of controlled cooling channels – about **N=72pc**

Requirements for TPC gas volume temperature stabilization:
T=(To **+/- 0.25)** degree