Cooling

A.Jeremie

Nouvelles de MARTA

Message de Ryszard le 6 avril

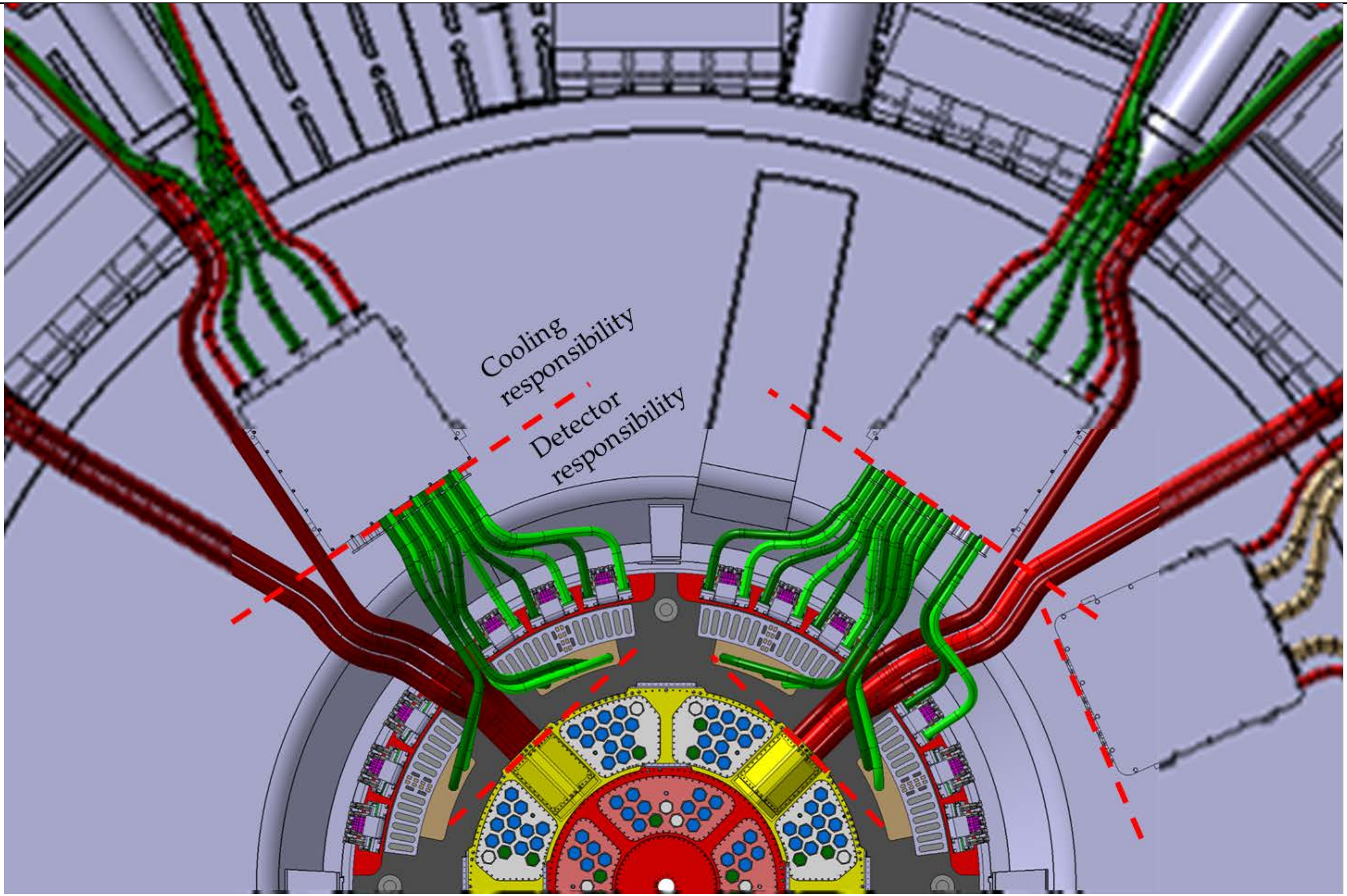
You can do some preparations and then we would be able start MARTA with my remote assistance.

- 1. Connect MARTA Local Box to the Experiment. Open MV5 and MV6.
- 2. Make a vacuum and then load CO2 (1,5 kg for the volume of MARTA + max 0,3 kg for the volume of Experiment).
- 3. Plug in the electric power and verify, if MARTA starts with no problems and alarms indicated on the HMI.
- 4. Then you can start MARTA. If connected do the internet, I can assist remotely (if you grant me the remote access to MARTA, I will be able to take over the control) or please wait until we will do it during the visit.

AUW

- The CERN cooling group (Bart in particular) has become increasingly worried, that the ITk community is not looking carefully enough at the ITk-internal parts of the cooling system
- In particular there are reviews ongoing or have been passed already for local supports and services, which have not discussed cooling issues in much depth
- (I agree with that observation)
- Bart therefore has been pushing for a review of the ITk cooling
- However, I think we can’t have multiple reviews of the same item
- We have discussed this with Claudia and the plan is now that we handle cooling similarly to grounding & shielding
  - This means that we will produce a document which outlines for each subsystem
    - The cooling requirements
    - The specifications and design
    - A prediction of the performance, if possible by prototype verification
  - This will be done together with the CERN cooling group, which will look at our inputs critically
  - This document will need to be approved by the Steering group, subsystems will need to conform to the content of that document
  - I have promised that we will produce such a document June/July

AUW



Pixel Thermal & Cooling Requirements

- Pixel on-detector thermal and cooling requirements defined in Local Supports & Global Mechanics specifications:
  - Local Supports: EDMS 1534572
  - Pixel Global Mechanics1: EDMS 2016196

* To be updated to include more detail on cooling requirements following recommendations from SPR Follow-up

Thermal Performance

(prevent runaway & guarantee Ipixel<10nA)

	TFM [°C·cm²·W⁻¹]	
Layer	**Design**	**Total**
0	20.5	28.5
1	27.8	37.2
2	27.3	36.5
3	31.3	42.4
4	33.6	45.9

Under revision to account for new R_{L0} and guarantee a minimum temperature in the periphery of the FE chips

Thermo-fluidic Performance

Cooling Loop Design Parameters	
Maximum Temperature @ PP1 (°C)	-40
$T_{max,\ inlet\ evaporator}$ (°C)	-35
$\Delta P_{PP1 \rightarrow PP1}$ (bar)	10
$\Delta P_{evaporator\ +\ exhaust}$ (bar)	≤2bar
$x_{max,\ exhaust}$ (%)	33
Nominal Power Dissipation (W/cm²)	0.7

Not conservative everywhere (see next slides)

OB Local Supports: Power Dissipation

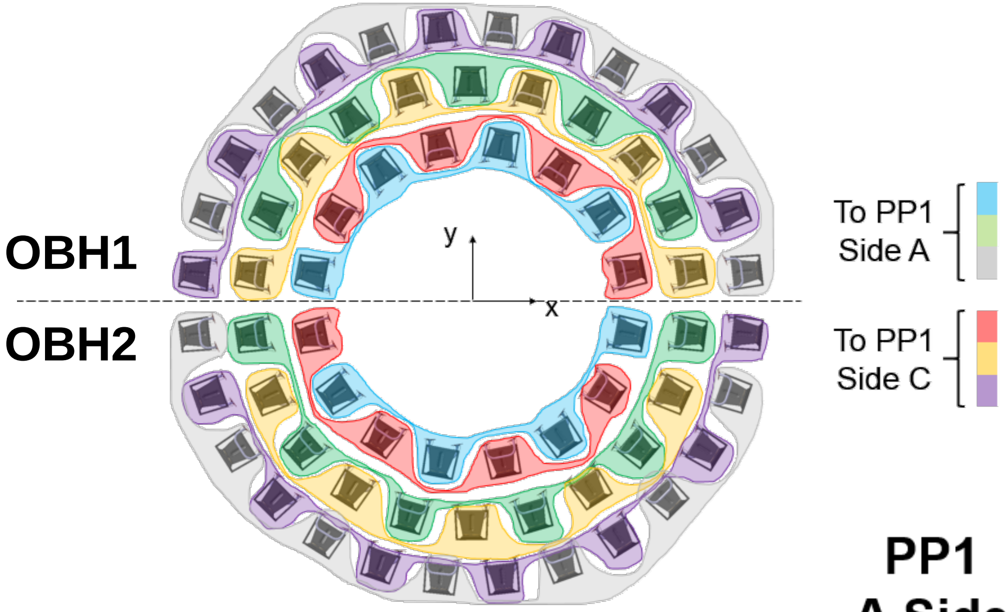
- Pixel Power Consumption model summarised in EDMS 2027500 (M. Hamer)

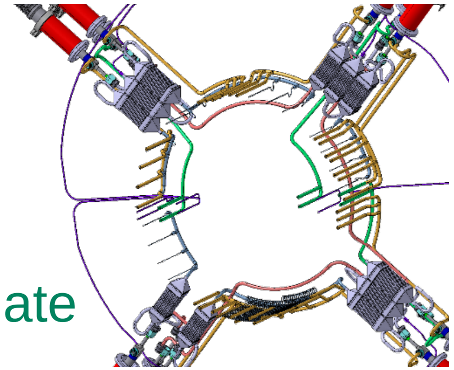
OB Local Support		Local Support Power Dissipation [W]			Difference with Nominal Case [%]	
Local Support Type & Flavour	**Number of Modules in LS**	**Nominal Case** (LS Specs – $0.7 W/cm^2$)	**High Power Scenario**	**20% Current Headroom**	**High Power Scenario**	**20% Current Headroom**
Longeron L2	36	**417.6**	**502.5**	**457.0**	**20.3**	9.4
Longeron L3	36	**417.6**	**454.2**	**438.2**	8.8	4.9
Longeron L4	36	**417.6**	**435.4**	**413.4**	4.3	-1.0
Inclined Half Ring L2	16	**185.6**	**226.2**	**203.8**	**21.9**	9.8
Inclined Half Ring L3	22	**255.2**	**272.2**	**265.2**	6.7	3.9
Inclined Half Ring L4	28	**324.8**	**326.6**	**316.4**	0.6	-2.6

We will qualify the OB design for 120% of the nominal loads (see prototyping section)

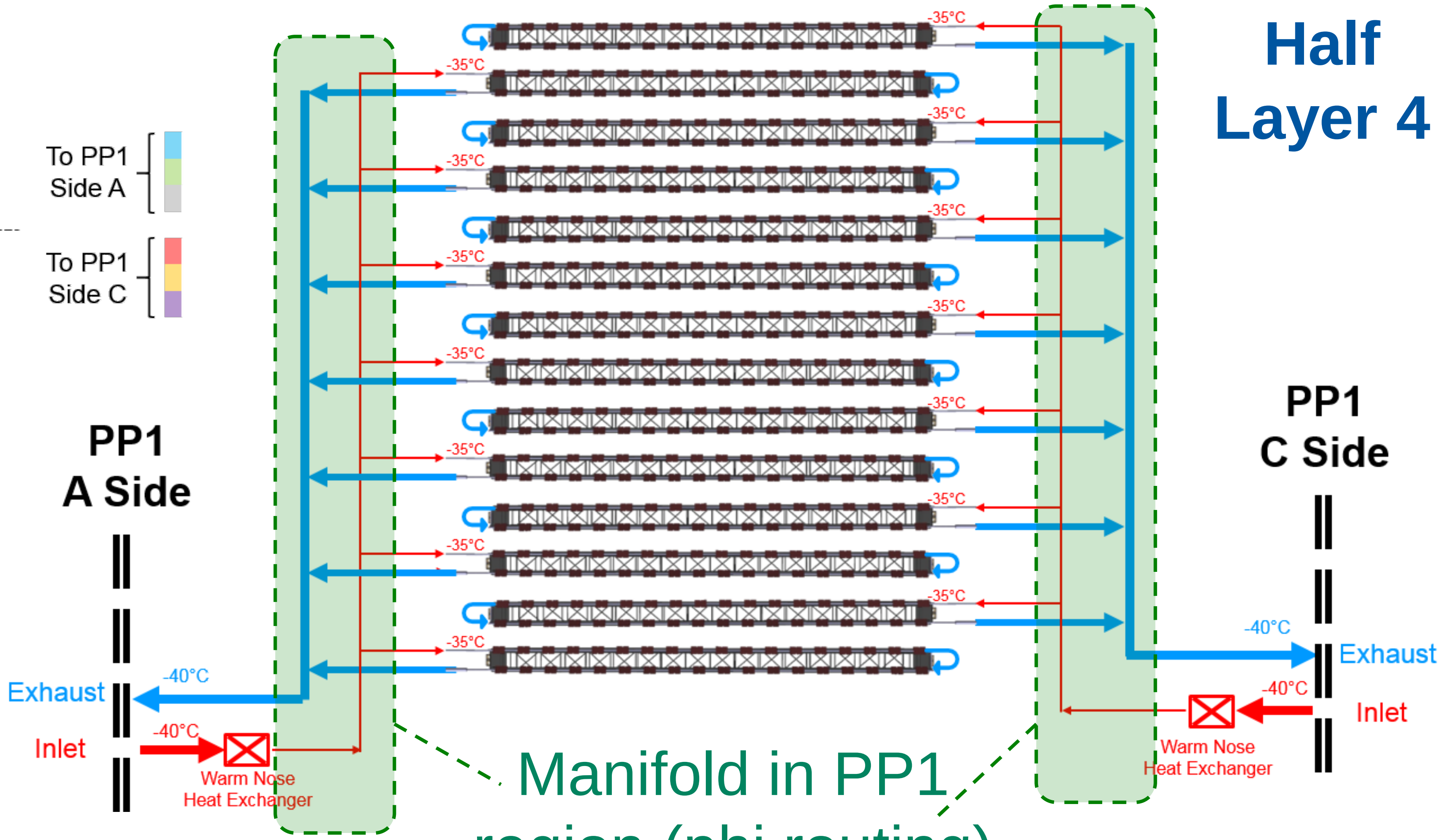
Pipe Extensions & Manifolds: Flat Region

- ~~Longerons from a given half layer are split in A&C sides and manifold together at PP1~~
  - Individual inlet capillary and exhaust pipe for each longeron





Not up-to-date



Manifold in PP1 region (phi routing)